

CONTRIBUTIONS FROM THE OBSERVATORY OF
COLUMBIA UNIVERSITY, NEW YORK.—No. 18.

JOHN K. REES, Director.

THE
PARALLAX OF μ CASSIOPEIÆ,
AND THE
POSITIONS OF 56 NEIGHBORING STARS
AS DEDUCED FROM THE
RUTHERFURD PHOTOGRAPHIC MEASURES.

GEORGE N. BAUER.

Submitted in partial fulfillment of the requirements for the degree of Doctor of
Philosophy in the University Faculty of Pure Science,
Columbia University.

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PREFACE.

The paper herewith presented was prepared by Mr. George N. Bauer while a graduate student at Columbia University in the Department of Astronomy, and was read, by title, before the Section of Astronomy, Physics and Chemistry of the New York Academy of Sciences on February 5th, 1900.

The Columbia University Observatory is enabled to print this paper from funds supplied by Rutherford Stuyvesant, Esq.

JOHN KROM REES,
Professor of Astronomy
and Director of the Observatory.

COLUMBIA UNIVERSITY, March, 1901.



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I. INTRODUCTION.

Statement of Problem.—Two problems have been treated in the present paper; the first is the determination of the parallax of μ Cassiopeiæ, which has become historic. Following Bessel no less than six astronomers have made and reduced observations to determine the parallax of this star, while still others have discussed the various values. It seemed desirable to solve the problem again. It was hoped that a new solution would add to the accuracy of the parallax and incidentally show that the photographic method is well adapted to solve problems of this nature.

The second problem is the determination of the coördinates of 56 stars about μ Cassiopeiæ.

The problem of proper motion also presented itself. The parallax equations contain a proper motion term hence their solution involves a proper motion determination. Again, in finding the catalogue position of μ Cassiopeiæ it was convenient to determine the proper motion.

The scale value has also been considered at some length. The value had already been found by Professor Jacoby (1, p. 269), but it seemed well to determine it again by methods entirely independent of those used in the earlier determination.

Data.—Twenty-eight Rutherford photographic plates were used. These are part of the series presented to Columbia Observatory, November 13, 1890, by Lewis M. Rutherford. (Rees, 2, p. 7; 3).

It will not be necessary for me to describe the plates at this time for that has already been done (1; 4, '98) at some length.

The accompanying table will indicate the general material used. It is sufficiently explicit so no words of explanation are necessary. It may be added, however, that the numbers of the plates are those given by Rutherford. They are the continuation of a series and hence do not begin with number one.

Table No. I, is identical with the corresponding table given by Professor Jacoby (5, '93) in his paper on the "Parallaxes of μ and θ Cassiopeiæ. It is reprinted here for convenience.

TABLE I.—GENERAL DATA.

Lat. $40^{\circ} 43' 48''.5$ Long. $4^h 55^m 56^s.62$ W.

Plate No.	Date.	Sideral Time.	Hour Angle	Zen. Dist.	Parall. Angle.	Ext. Temp.	Focal Mic'r.
		h m s	h m s	o			
31	1870 July 23	20 47 45	19 47 59	43.05	— 81.46	79	7.7
32	1870 July 23	21 56 35	20 56 49	33.04	— 95.07	79	7.7
33	1870 July 30	20 15 15	19 15 29	47.70	— 75.78	70	7.9
34	1870 July 30	20 43 35	19 43 49	43.67	— 80.70	70	7.9
36	1871 July 10	20 39 38	19 39 52	44.22	— 80.00	76	7.9
37	1871 July 10	21 20 8	20 20 22	38.36	— 87.51	76	7.9
38	1871 July 23	20 30 5	19 30 19	45 60	— 78.33	65	8.1
40	1872 Jan. 2	4 5 30	3 5 44	33.41	+ 94.50	30	7.9
41	1872 Jan. 2	5 4 28	4 4 42	42 01	+ 82.77	30	7.9
42	1872 Jan. 5	2 23 0	1 23 14	19.39	+ 125 83	35	7.9
43	1872 July 19	21 3 2	20 3 16	40.85	— 84 24	71	7.9
44	1872 July 19	21 38 52	20 39 6	35.63	— 91.26	71	7.9
45	1872 July 20	21 13 8	20 13 22	39.38	— 86.14	73	7.9
46	1872 July 20	21 49 42	20 49 56	34.04	— 93.56	73	7.9
47	1873 Jan. 6	3 26 32	2 26 46	27.80	+ 103.96	26	7.9
48	1873 Jan. 9	4 6 28	3 6 42	33.55	+ 94.29	24	7.9
49	1873 Jan. 9	4 40 2	3 40 16	38.45	+ 87.37	24	7.9
50	1873 Jan. 10	3 32 2	2 32 16	28.59	+ 102.50	21	7.95
51	1873 July 15	21 46 42	20 46 56	34.49	— 92.91	75	7.75
52	1873 July 21	20 52 52	19 53 6	42 32	— 82.37	69	7.8
53	1873 July 21	21 27 52	20 28 6	37.23	— 89.03	69	7.8
54	1873 July 23	19 49 48	18 50 2	51.26	— 71.50	75	7.75
55	1873 July 23	20 33 8	19 33 22	45.16	— 78.85	75	7.75
56	1873 July 23	21 8 58	20 9 12	39.98	— 85.35	75	7.75
57	1873 Dec. 18	4 14 18	3 14 32	34.69	+ 92.60	41	7.8
58	1873 Dec. 18	4 50 18	3 50 32	39.95	+ 85.40	41	7.8
59	1873 Dec. 21	2 36 38	1 36 52	21.06	+ 120.12	27	7.9
60	1873 Dec. 21	3 10 12	2 10 26	25.52	+ 108.61	27	7.9

Method.—In reducing the measures the following corrections were applied to the distances :

- (1) refraction,
- (2) aberration,
- (3) division error,
- (4) tangent correction,
- (5) proper motion,
- (6) parallax.

The position angles were corrected as follows :

- (1) refraction,
- (2) zero correction,
- (3) proper motion,
- (4) orientation,
- (5) parallax.

After these corrections were applied to the distances and position angles, the differences of right ascension and declination were calculated.

In finding the parallax, nothing but the position angles were used. By this method but one comparison star is used for any set of equations of condition. Thus we have as many independent determinations as there are stars of comparison. Professor Harold Jacoby (5, '93) has used the distances to determine the parallax, so it seemed desirable to solve the problem by using the position angles. This offers a means of comparison between the two methods. One may serve as a check upon the other.

The scale value was found by comparing the star positions as found on the plates with the positions as given in the catalogue. For this purpose fourteen stars were chosen as standards. In connection with the scale value, a solution was made to determine the orientation correction anew.

II. CORRECTIONS.

Refraction.—Since the given coördinates are distance and position angle, we may use the well-known formulæ (6, Chauvenet, p. 459).

$$\frac{\sigma - s}{s} = \kappa \{ \tan^2 \zeta \cos^2 (\phi - q) + 1 \}$$

$$\pi - \phi = -\kappa \operatorname{cosec} I'' \tan^2 \zeta \sin (\phi - q) \cos (\phi - q)$$

where

σ = distance corrected for refraction.

s = distance before corrected.

π = position angle corrected for refraction.

ϕ = position angle before corrected.

q = parallactic angle for central star.

ζ = zenith distance of central star.

κ = constant of refraction.

The constant of refraction, κ , was computed according to the formula

$$\kappa = a'' . B . T . \left. \begin{array}{l} 66 \\ 65 \end{array} \right\}$$

In a paper written by M. Prosper Henry (7, p. 464), attention is called to the fact that the different colors are differently refracted. He then adds, "Ce phénomène est bien marqué lorsqu' on observe dans un telescope une étoile peu élevée au-dessus de l'horizon : l'image de celle-ci, au lieu d'être un simple point, se présente comme un petit spectre vertical." This fact must be remembered in reducing photographic plates. The rays that have the greatest effect upon the plate, the violet, are those which are refracted the most. M. Prosper Henry comes to the conclusion that " . . . Pour calculer la réfraction photographique en partant de la réfraction ordinaire, ajouter à cette dernière $\frac{0.91}{58.22}$ on 0.0156 de sa valeur. Sans cette correction, les refractions absolues seraient erronées de 5'' pour $z = 80^\circ$." The differential refraction would be in error about 0''.15 for a distance of 1° with a zenith distance of 70° . It will be noticed that this factor, by which the refraction is to be increased, is practically the same as the factor used in the above formula, $\frac{1}{65}$ (or .0154). Professor Scheiner (8, p. 247) has

taken the mean of the values as measured by Ketteler, Lorenz, Mascart and Kayser, and Runge. He finds the factor $\frac{1}{6.5}$.

The data necessary to compute κ , together with $\log \kappa$, is given in the accompanying table.

TABLE II.

No. of Plate.	Zen. Dis.	Bar.	Att. τ .	Ext. τ .	Log. κ .
	[°]	^{in.}	[°]	[°]	
31	43.05	30.18	80	79	6.4325
32	33.04	30.18	80	79	6.4332
33	47.70	30.18	73	70	6.4394
34	43.67	30.18	73	70	6.4400
36	44.22	29.94	77	76	6.4316
37	38.36	29.93	77	76	6.4319
38	45.60	30.26	66	65	6.4454
40	33.41	30.49	33	30	6.4807
41	42.01	30.49	33	30	6.4801
42	19.39	29.88	36	35	6.4680
43	40.85	30.05	72	71	6.4376
44	35.63	30.05	72	71	6.4380
45	39.38	30.12	74	73	6.4370
46	34.04	30.13	74	73	6.4376
47	27.80	30.30	28	26	6.4821
48	33.55	30.02	26	24	6.4797
49	38.45	30.02	26	24	6.4794
50	28.59	30.10	23	21	6.4838
51	34.49	30.04	77	75	6.4345
52	42.32	30.22	69	69	6.4417
53	37.23	30.22	69	69	6.4421
54	51.26	30.12	76	75	6.4338
55	45.16	30.12	76	75	6.4348
56	39.98	30.12	76	75	6.4353
57	34.69	30.05	42	41	6.4626
58	39.95	30.05	42	41	6.4623
59	21.06	30.39	29	27	6.4800
60	25.52	30.39	29	27	6.4798

On account of the number of stars found on the plates, it seemed advisable to tabulate the refraction for every ten degrees. The refraction may then easily be applied by interpolation. It will be noticed that the corrections for distance, as given in the tables, must be multiplied by the distance before they can be applied, while the corrections to the angles are given direct.

The corrections, due to refraction, are given in Table III.

TABLE III.

PLATE 31.

ρ	$\frac{\sigma-s}{s} \times 10^3$	$\pi-\rho$
279	99	+ .507
289	109	500
299	119	479
309	129	448
319	139	409
329	149	368
339	159	330
349	169	298
359	179	278
9	189	271
19	199	278
29	209	298
39	219	330
49	229	368
59	239	409
69	249	448
79	259	479
89	269	+ .500

PLATE 32.

ρ	$\frac{\sigma-s}{s} \times 10^3$	$\pi-\rho$
265	85	.386
275	95	.382
285	105	.372
295	115	.357
305	125	.338
315	135	.319
325	145	.300
335	155	.285
345	165	.277
355	175	.271
5	185	.277
15	195	.285
25	205	.300
35	215	.319
45	225	.338
55	235	.357
65	245	.372
75	255	.382

PLATE 33.

ρ	$\frac{\sigma-s}{s} \times 10^3$	$\pi-\rho$
284	104	+ .607
294	114	597
304	124	568
314	134	524
324	144	470
334	154	412
344	164	358
354	174	314
4	184	285
14	194	275
24	204	285
34	214	314
44	224	358
54	234	412
64	244	470
74	254	524
84	264	568
94	274	+ .597

PLATE 34.

ρ	$\frac{\sigma-s}{s} \times 10^3$	$\pi-\rho$
279	99	+ .526
289	109	519
299	119	497
309	129	464
319	139	423
329	149	379
339	159	338
349	169	305
359	179	283
9	189	275
19	199	283
29	209	305
39	219	338
49	229	379
59	239	423
69	249	464
79	259	497
89	269	+ .519

TABLE III—Continued..

PLATE 36.

p	$\frac{\sigma-s}{s} \times 10^3$	$\pi-p$
280	100	+ .526
290	110	518
300	120	496
310	130	462
320	140	420
330	150	376
340	160	334
350	170	300
0	180	278
10	190	270
20	200	278
30	210	300
40	220	334
50	230	376
60	240	420
70	250	462
80	260	496
90	270	518

PLATE 37.

p	$\frac{\sigma-s}{s} \times 10^3$	$\pi-p$
273	93	+ .440
283	103	435
293	113	420
303	123	397
313	133	370
323	143	340
333	153	313
343	163	290
353	173	275
3	183	270
13	193	275
23	203	290
33	213	313
43	223	340
53	233	370
63	243	397
73	253	420
83	263	+ .435

PLATE 38.

p	$\frac{\sigma-s}{s} \times 10^3$	$\pi-p$
282	102	+ .570
292	112	561
302	122	536
312	132	497
322	142	450
332	152	399
342	162	352
352	172	313
2	182	288
12	192	279
22	202	288
32	212	313
42	222	352
52	232	399
62	242	450
72	252	497
82	262	536
92	272	+ .561

PLATE 40.

p	$\frac{\sigma-s}{s} \times 10^3$	$\pi-p$
95	275	+ .434
105	285	430
115	295	419
125	305	401
135	315	380
145	325	349
155	335	335
165	345	318
175	355	310
185	5	302
195	15	310
205	25	318
215	35	335
225	45	349
235	55	380
245	65	401
255	75	419
265	85	+ .430

TABLE III.—*Continued.*

PLATE 41.

ρ	$\frac{\sigma-s}{s} \times 10^3$	$\pi-\rho$
83	263	+ .547
93	273	528
103	283	518
113	293	486
123	303	446
133	313	403
143	323	363
153	333	331
163	343	309
173	353	302
183	3	309
193	13	331
203	23	363
213	33	403
223	43	446
233	53	486
243	63	518
253	73	+ .528

PLATE 42.

ρ	$\frac{\sigma-s}{s} \times 10^3$	$\pi-\rho$
126	306	+ .330
136	316	329
146	326	326
156	336	321
166	346	315
176	356	309
186	6	303
196	16	298
206	26	295
216	36	294
226	46	295
236	56	298
246	66	303
256	76	309
266	86	315
276	96	321
286	106	326
296	116	+ .329

PLATE 43.

ρ	$\frac{\sigma-s}{s} \times 10^3$	$\pi-\rho$
276	96	.479
286	106	473
296	116	455
306	126	428
316	136	394
326	146	359
336	156	325
346	166	291
356	176	250
6	186	274
16	196	280
26	206	291
36	216	325
46	226	359
56	236	394
66	246	428
76	256	455
86	266	.473

PLATE 44.

ρ	$\frac{\sigma-s}{s} \times 10^3$	$\pi-\rho$
269	89	+ .415
279	99	411
289	109	399
299	119	380
309	129	357
319	139	332
329	149	309
339	159	291
349	169	281
359	179	274
9	189	281
19	199	291
29	209	309
39	219	332
49	229	357
59	239	380
69	249	399
79	259	+ .411

TABLE III.—*Continued.*

PLATE 45.

p	$\frac{\sigma-s}{s} \times 10^3$	$\pi-p$
274	94	+ .458
284	104	452
294	114	436
304	124	412
314	134	382
324	144	350
334	154	320
344	164	295
354	174	279
4	184	274
14	194	279
24	204	295
34	214	320
44	224	350
54	234	382
64	244	412
74	254	436
84	264	452

PLATE 46.

p	$\frac{\sigma-s}{s} \times 10^3$	$\pi-p$
266	86	+ .399
276	96	395
286	106	384
296	116	368
306	126	347
316	136	326
326	146	305
336	156	289
346	166	278
356	176	274
6	186	278
16	196	289
26	206	305
36	216	326
46	226	347
56	236	368
66	246	384
76	256	395

PLATE 47.

p	$\frac{\sigma-s}{s} \times 10^3$	$\pi-p$
104	284	.388
114	294	385
124	304	378
134	314	367
144	324	353
154	334	338
164	344	325
174	354	313
184	4	306
194	14	304
204	24	306
214	34	313
224	44	325
234	54	338
244	64	353
254	74	367
264	84	378
274	94	385

PLATE 48.

p	$\frac{\sigma-s}{s} \times 10^3$	$\pi-p$
94	274	+ .435
104	284	431
114	294	419
124	304	401
134	314	380
144	324	341
154	334	335
164	344	317
174	354	306
184	4	302
194	14	306
204	24	317
214	34	335
224	44	341
234	54	380
244	64	401
254	74	419
264	84	431

TABLE III.—*Continued.*

PLATE 49.

ρ	$\frac{\sigma-s}{s} \times 10^3$	$\pi-\rho$
87	267	+ .492
97	277	— 0.0
107	287	6.7
117	297	12.6
127	307	17.0
137	317	19.3
147	327	19.3
157	337	17.0
167	347	12.6
177	357	— 6.7
187	7	+ 0.0
197	17	6.7
207	27	12.6
217	37	17.0
227	47	19.3
237	57	19.3
247	67	17.0
257	77	12.6
		+ .486
		+ 6.7

PLATE 50.

ρ	$\frac{\sigma-s}{s} \times 10^3$	$\pi-\rho$
103	283	— 0.0
113	293	3.2
123	303	392
133	313	6.0
143	323	385
153	333	373
163	343	358
173	353	9.2
183	3	342
193	13	327
203	23	315
213	33	307
223	43	305
233	53	307
243	63	315
253	73	327
263	83	342
273	93	358
		+ .392
		— 3.2

PLATE 51.

ρ	$\frac{\sigma-s}{s} \times 10^3$	$\pi-\rho$
267	87	+ .400
277	97	— 0.0
287	107	4.5
297	117	8.5
307	127	11.5
317	137	13.0
327	147	13.0
337	157	11.5
347	167	8.5
357	177	287
7	187	276
17	197	272
27	207	272
37	217	276
47	227	286
57	237	304
67	247	325
77	257	347
		368
		385
		+ .397
		— 4.5

PLATE 52.

ρ	$\frac{\sigma-s}{s} \times 10^3$	$\pi-\rho$
278	98	+ .506
288	108	— 0.0
298	118	8.1
308	128	15.2
318	138	20.5
328	148	411
338	158	23.3
348	168	371
358	178	334
8	188	303
18	198	276
28	208	283
38	218	283
48	228	276
58	238	303
68	248	371
78	258	411
88	268	448
		479
		+ .499
		15.2
		8.1
		20.5
		23.3
		23.3
		25.2
		28.1
		30.5
		32.3
		34.1
		35.8
		37.3
		38.5
		39.2
		40.0
		40.7
		41.5
		42.6
		43.7
		44.8
		45.9
		47.0
		48.1
		49.2
		50.3
		51.4
		52.5
		53.6
		54.7
		55.8
		56.9
		58.0
		59.1
		60.2
		61.3
		62.4
		63.5
		64.6
		65.7
		66.8
		67.9
		69.0
		70.1
		71.2
		72.3
		73.4
		74.5
		75.6
		76.7
		77.8
		78.9
		80.0
		81.1
		82.2
		83.3
		84.4
		85.5
		86.6
		87.7
		88.8
		89.9
		91.0
		92.1
		93.2
		94.3
		95.4
		96.5
		97.6
		98.7
		99.8
		100.9
		102.0
		103.1
		104.2
		105.3
		106.4
		107.5
		108.6
		109.7
		110.8
		111.9
		113.0
		114.1
		115.2
		116.3
		117.4
		118.5
		119.6
		120.7
		121.8
		122.9
		124.0
		125.1
		126.2
		127.3
		128.4
		129.5
		130.6
		131.7
		132.8
		133.9
		135.0
		136.1
		137.2
		138.3
		139.4
		140.5
		141.6
		142.7
		143.8
		144.9
		146.0
		147.1
		148.2
		149.3
		150.4
		151.5
		152.6
		153.7
		154.8
		155.9
		157.0
		158.1
		159.2
		160.3
		161.4
		162.5
		163.6
		164.7
		165.8
		166.9
		168.0
		169.1
		170.2
		171.3
		172.4
		173.5
		174.6
		175.7
		176.8
		177.9
		179.0
		180.1
		181.2
		182.3
		183.4
		184.5
		185.6
		186.7
		187.8
		188.9
		190.0
		191.1
		192.2
		193.3
		194.4
		195.5
		196.6
		197.7
		198.8
		199.9
		201.0
		202.1
		203.2
		204.3
		205.4
		206.5
		207.6
		208.7
		209.8
		210.9
		212.0
		213.1
		214.2
		215.3
		216.4
		217.5
		218.6
		219.7
		220.8
		221.9
		223.0
		224.1
		225.2
		226.3
		227.4
		228.5
		229.6
		230.7
		231.8
		232.9
		234.0
		235.1
		236.2
		237.3
		238.4
		239.5
		240.6
		241.7
		242.8
		243.9
		245.0
		246.1
		247.2
		248.3
		249.4
		250.5
		251.6
		252.7
		253.8
		254.9
		256.0
		257.1
		258.2
		259.3
		260.4
		261.5
		262.6
		263.7
		264.8
		265.9
		267.0
		268.1
		269.2
		270.3
		271.4
		272.5
		273.6
		274.7
		275.8
		276.9
		278.0
		279.1
		280.2
		281.3
		282.4
		283.5
		284.6
		285.7
		286.8
		287.9
		289.0
		290.1
		291.2
		292.3
		293.4
		294.5
		295.6
		296.7
		297.8
		298.9
		300.0

TABLE III.—Continued.

PLATE 53.

p	$\frac{\sigma-s}{s} \times 10^3$	$\pi-p$
27I	9I	+ .437
28I	10I	432
29I	11I	418
30I	12I	397
31I	13I	371
32I	14I	343
33I	15I	317
34I	16I	296
35I	17I	285
I	18I	277
1I	19I	285
2I	20I	296
3I	21I	317
4I	22I	343
5I	23I	371
6I	24I	397
7I	25I	418
8I	26I	+ .432
		+ 5.6

PLATE 54.

p	$\frac{\sigma-s}{s} \times 10^3$	$\pi-p$
289	109	- .693
299	119	681
309	129	644
319	139	588
329	149	519
339	159	446
349	169	377
359	179	321
9	189	284
19	199	272
29	209	284
39	219	321
49	229	377
59	239	446
69	249	519
79	259	588
89	269	644
99	279	.681
		-15.9

PLATE 55.

p	$\frac{\sigma-s}{s} > 10^3$	$\pi-p$
28I	10I	+ .547
29I	11I	539
30I	12I	515
31I	13I	479
32I	14I	434
33I	15I	386
34I	16I	341
35I	17I	301
I	18I	280
1I	19I	272
2I	20I	280
3I	21I	304
4I	22I	341
5I	23I	386
6I	24I	434
7I	25I	479
8I	26I	515
9I	27I	.539
		+ 9.7

PLATE 56.

p	$\frac{\sigma-s}{s} < 10^3$	$\pi-p$
275	95	.464
285	105	458
295	115	442
305	125	416
315	135	385
325	145	352
335	155	320
345	165	295
355	175	278
5	185	272
15	195	278
25	205	295
35	215	320
45	225	352
55	235	385
65	245	416
75	255	442
85	265	+ .458
		+ 6.8

TABLE III.—*Continued.*

PLATE 57.

ρ	$\sigma-s$ s	$\times 10^3$	$\pi-\rho$
93	273	.429	— 0.0
103	283	.425	4.9
113	293	.413	9.2
123	303	.394	12.4
133	313	.372	14.1
143	323	.347	14.1
153	333	.325	12.4
163	343	.306	9.2
173	353	.294	— 4.9
183	3	.290	+ 0.0
193	13	.294	4.9
203	23	.306	9.2
213	33	.325	12.4
223	43	.347	14.1
233	53	.372	14.1
243	63	.394	12.4
253	73	.413	9.2
263	83	+.425	+ 4.9

PLATE 58.

ρ	$\sigma-s$ s	$\times 10^3$	$\pi-\rho$
85	265	+.493	— 0.0
95	275	.487	7.2
105	285	.470	13.5
115	295	.442	18.2
125	305	.409	20.6
135	315	.374	20.6
145	325	.341	18.2
155	335	.314	13.5
165	345	.296	— 7.2
175	355	.290	+ 0.0
185	5	.296	7.2
195	15	.314	13.5
205	25	.341	18.2
215	35	.374	20.6
225	45	.409	20.6
235	55	.442	18.2
245	65	.470	13.5
255	75	+.487	+ 7.2

PLATE 59.

ρ	$\sigma-s$ s	$\times 10^3$	$\pi-\rho$
120	300	+.347	— 0.0
130	310	.346	1.6
140	320	.342	3.0
150	330	.333	4.0
160	340	.323	4.6
170	350	.321	4.6
180	0	.313	4.0
190	10	.307	3.0
200	20	.303	— 1.6
210	30	.302	+ 0.0
220	40	.303	1.6
230	50	.307	3.0
240	60	.313	4.0
250	70	.321	4.6
260	80	.323	4.6
270	90	.333	4.0
280	100	.342	3.0
290	110	+.346	+ 1.6

PLATE 60.

ρ	$\sigma-s$ s	$\times 10^3$	$\pi-\rho$
109	289	+.371	— 0.0
119	299	.369	2.4
129	309	.363	4.6
139	319	.354	6.1
149	329	.342	7.0
159	339	.330	7.0
169	349	.319	6.1
179	359	.310	4.6
189	9	.304	— 2.4
199	19	.302	+ 0.0
209	29	.304	2.4
219	39	.310	4.6
229	49	.319	6.1
239	59	.330	7.0
249	69	.342	7.0
259	79	.354	6.1
269	89	.363	4.6
279	99	+.369	+ 2.4

Precession, Nutation and Aberration.—The subjects of precession, nutation and aberration have been treated so fully by Bessel (9, p. 202) and Chauvenet that it will not be necessary, in the present paper, to say much concerning them. It will be remembered that precession and nutation affect all the position angles of any one plate equally, while the distances are not changed in the least by them. The aberration correction for position angles is also a constant for any plate; but unlike precession and nutation, it does affect the distances. The formula for aberration shows that the effect upon the distances is independent of the directions in which these distances are measured.

For purposes of calculation Bessel employs the formulæ in terms of his star numbers. The correction for position angle becomes,

$$\Delta p = -Aa' - B\beta' - C\gamma' - D\delta'$$

where

$$a' = n \sin a_0 \sec \delta_0,$$

$$\beta' = \cos a_0 \sec \delta_0.$$

$$\gamma' = \cos a_0 \tan \delta_0$$

$$\delta' = \sin a_0 \tan \delta_0$$

a_0, δ_0 = the star's mean right ascension and declination at the beginning of the fictitious year.

The annual increase in position angle is $n \sec \delta_0 \sin a_0$. For the position of μ Cassiopeiae this reduces to $8''.86$.

To reduce the plates of μ Cassiopeiae to 1872.0 we have the following corrections:

$$\text{For the plates taken in '70, } 17''.72 + \Delta p$$

$$\text{For the plates taken in '71, } 8''.86 + \Delta p$$

$$\text{For the plates taken in '72, } 0''.00 + \Delta p$$

$$\text{For the plates taken in '73, } -8''.86 + \Delta p$$

where we have

$$\Delta p = [0.9473_n]A + [0.2190_n]B + [0.1285_n]C + [9.5547_n]\Delta.$$

For the distances we have

$$\Delta s = s(C\gamma + \Delta\delta)$$

where

$$\gamma = (\tan \epsilon \sin \delta + \sin a \cos \delta) \sin 1''$$

(a, δ) = apparent right ascension and declination.

For our plates we have

$$\Delta s = s \{ [4.3860] C + [4.4367_n] D \}$$

In addition to these corrections we have a correction for the western image (Jacoby, I, p. 277) due to the method of measuring the plates. This is of the form $k/h \tan \delta$, h is distance between eastern and western images. It has also been shown (10, Jacoby, p. 131) that each plate requires a special correction of the form

$$\frac{1}{2} k z \tan \delta - y$$

where

- k = scale value in seconds.
- z = distance of last impression of central star.
- δ = declination of central star.
- y = refraction for position angle 270° .

If we now add all the corrections the position angles suffer, we have

$$\text{Correction} = \frac{1}{2} k \tan \delta. (z - h) - y + x$$

where x is the correction due to precession and nutation.

In the accompanying table are given the values of h and z , as well as each term of the correction for position angle. The last column gives the aberration factor to correct the distances.

Division Error.—The glass scale with which the distances were measured was investigated in 1890. The results of this investigation are tabulated in the Pleiades (I, p. 250) paper. All the distances were corrected for division error by means of this table.

Tangent Correction.—The distances as measured are the projections of a portion of the sky upon the photographic plate. These projections are not the angular distances, but rather the tangents of these distances. It is necessary, therefore, to add another correction which affects the distances only—called the tangent correction. It is of the form

$$- \frac{1}{3} s^3 \sin^2 1'' \text{ (II, p. 131)}$$

This correction has been tabulated. It is given in terms of seconds of arc and also in terms of d , the division of the scale. It is in this latter form that it was applied to the distances.

TABLE IV.

Plate.	h	z	$\frac{1}{2}k(z-h) \tan \delta$	$-y$	$+x$	Cor'n	$(Cy+D\delta) \times 10^8$
31	1.311	57.366	18' 12"	- 8"	+ 4"	18' 8"	+.0714
32	1.186	57.432	18 15	+ 2	+ 4	18 21	+.0714
33	1.295	70.376	22 26	-16	+ 1	22 11	+.0721
34	1.913	62.423	19 40	- 9	+ 1	19 32	+.0721
36	1.346	62.881	19 59	- 9	+ 5	19 55	+.0674
37	1.389	63.420	20 9	- 2	+ 5	20 12	+.0675
38	1.481	62.312	19 45	-10	+ 0	19 35	+.0714
40	1.350	68.327	21 45	- 2	+ 3	21 46	-.0642
41	1.677	62.898	19 53	+ 6	+ 3	20 2	-.0642
42	1.319	62.783	19 58	- 3	+ 4	19 59	-.0658
43	1.505	62.969	19 58	- 3	- 3	19 52	+.0706
44	1.268	67.628	21 33	+ 0	- 3	21 30	+.0707
45	1.546	62.415	19 46	- 3	- 3	19 40	+.0709
46	1.760	68.032	21 31	+ 2	- 3	21 30	+.0709
47	2.335	60.090	18 46	- 4	+ 0	18 42	-.0667
48	2.324	57.006	17 45	- 2	+ 2	17 45	-.0681
49	2.898	57.106	17 36	+ 2	+ 2	17 40	-.0681
50	2.649	57.240	17 44	- 4	+ 2	17 42	-.0685
51	1.814	57.113	17 57	+ 1	- 6	17 52	+.0695
52	1.675	57.016	17 58	- 7	- 8	17 43	+.0711
53	2.133	56.969	17 47	- 1	- 8	17 38	+.0710
54	1.900	57.113	17 56	-27	- 9	17 20	+.0714
55	2.168	56.892	17 46	-10	- 9	17 27	+.0714
56	2.274	56.890	17 44	- 3	- 9	17 32	+.0714
57	1.826	57.203	17 59	- 2	-14	17 43	-.0537
58	1.406	57.213	18 7	+ 4	-14	17 57	-.0537
59	1.497	57.203	18 6	- 4	-12	17 50	-.0562
60	1.462	57.175	18 6	- 5	-12	17 49	-.0562

The first column of Table V gives the distance in seconds, the second in terms of the scale unit, while columns three and four give the corresponding corrections.

The table is arranged in such a manner that the corrections in seconds of arc are increased uniformly 1'' by each step.

Proper Motion.— μ Cassiopeiae has a considerable proper motion. Since all the stars were referred to μ , it is essential that this correction should be applied to both the distances and to the position angles.

Auwers' proper motion was used. It is :

$$\Delta\alpha = + 0''.3860 \quad \Delta\delta = - 1''.580.$$

TABLE V.

Distance.		Correction.		Distance.		Correction.	
"	d	"	d	"	d	"	d
0	0	— .00	— .0000	3107	110.92	— .24	— .0086
861	30.74	— .01	.0004	3151	112.50	— .25	.0090
1242	44.34	— .02	.0008	3193	113.99	— .26	.0093
1472	52.55	— .03	.0011	3233	115.42	— .27	.0096
1647	58.80	— .04	.0014	3274	116.89	— .28	.0100
1791	63.94	— .05	.0018	3313	118.28	— .29	.0104
1914	68.33	— .06	.0021	3352	119.67	— .30	.0107
2024	72.26	— .07	.0025	3389	120.99	— .31	.0111
2123	75.79	— .08	.0028	3426	122.31	— .32	.0114
2214	79.04	— .09	.0032	3461	123.56	— .33	.0118
2297	82.01	— .10	.0036	3496	124.81	— .34	.0121
2375	84.79	— .11	.0039	3531	126.06	— .35	.0124
2448	87.40	— .12	.0043	3565	127.28	— .36	.0128
2517	89.86	— .13	.0046	3598	128.45	— .37	.0132
2583	92.22	— .14	.0050	3631	129.63	— .38	.0136
2644	94.39	— .15	.0054	3663	130.78	— .39	.0139
2705	96.57	— .16	.0057	3694	131.88	— .40	.0143
2762	98.61	— .17	.0061	3724	132.95	— .41	.0146
2816	100.54	— .18	.0064	3754	134.02	— .42	.0150
2869	102.43	— .19	.0068	3783	135.06	— .43	— .0154
2919	104.21	— .20	.0071	3811	136.06		
2969	106.00	— .21	.0075				
3016	107.68	— .22	.0078				
3062	109.32	— .23	— .0082				

These values give a proper motion of $3''.730$ or $0^d.1332$ upon a great circle whose position angle (χ) is $115^\circ 3' 31''$.

Employing the notation that has been used in other papers published by this observatory, we have, for the distances

$$\Delta s = P_1 S_1 + P_2 S_2,$$

and for the position angle

$$\Delta \phi = S_1 P_3 (1 + S_1 P_1 \cdot S_3) + K$$

t = date of plate

$\tau = t - 1872.0$

ρ = annual motion on a great circle

χ = position angle of that great circle

$S_1 = \cos (\chi - \phi)$

$S_2 = -\frac{1}{2S} \sin^2 (\chi - \phi)$

$$P_1 = \tau \rho$$

$$P_2 = \tau^2 \rho^2$$

$$S_5 = \sin (\chi - \phi)$$

$$S_6 = \frac{1}{S}$$

$$S_7 = S_5 S_6$$

$$P_5 = \tau \rho \operatorname{cosec} 1''$$

$$K = - \{ P_1 \sin \chi \tan \delta + \frac{1}{2} P_2 \sin 1'' \sin \chi \cos \chi (1 + 2 \tan^2 \delta) \}.$$

In the problem now under consideration, the last term of K will always be zero, as may be shown by computing the case where its effect will be the largest. We then have

$$K = - P_1 \sin \chi \tan \delta$$

when K is expressed in divisions of the scale (d). To express in seconds we must multiply by 28.01.

The quantities that are constant for each plate are tabulated in the following table:

TABLE VI.

Plate No.	P_1	P_2	K	P_5	Plate No.	P_1	P_2	K	P_5
31	-.19150	.03667	+6.76	-39499.7	49	+.13642	.01861	-4.81	+28134.5
32	-.19150	.03667	+6.76	-39499.7	50	+.13678	.01871	-4.83	+28217.0
33	-.18870	.03561	+6.66	-38922.2	51	+.20516	.04209	-7.24	+42304.9
34	-.18870	.03561	+6.66	-38922.2	52	+.20732	.04298	-7.32	+42758.7
36	-.06299	.00397	+2.22	-12994.7	53	+.20732	.04298	-7.32	+42758.7
37	-.06299	.00397	+2.22	-12994.7	54	+.20804	.04328	-7.34	+42903.1
38	-.05566	.00310	+1.17	-10488.9	55	+.20804	.04328	-7.34	+42903.1
40	+.00072	.00000	-0.02	+ 144.4	56	+.20804	.04328	-7.34	+42903.1
41	+.00072	.00000	-0.02	+ 144.4	57	+.26174	.06851	-9.24	+54979.5
42	+.00180	.00000	-0.06	+ 371.3	58	+.26174	.06851	-9.24	+54979.5
43	+.07342	.00539	-2.59	+15139.8	59	+.26282	.06907	-9.28	+55206.4
44	+.07342	.00539	-2.59	+15139.8	60	+.26282	.06907	-9.28	+55206.4
45	+.07378	.00544	-2.60	+15222.3					
46	+.07378	.00544	-2.60	+15222.3					
47	+.13534	.01832	-4.78	+27907.6					
48	+.13642	.01861	-4.81	+28134.5					

The S 's have also been tabulated for the convenience of the reader. The table is self-explanatory. By means of the two tables it is comparatively easy to combine the S 's with the P 's and thus to find the proper motion correction for the distances and position angles.

TABLE VII.

No. of Star.	S_1 $\cos (\chi-\phi)$	S_2 $-\frac{1}{2} \sin^2 (\chi-\phi)$	S_6 1 s	S_7 $\sin (\chi-\phi)$ s
1	— .6696	— .00218	.00790	— .00587
2	— 1.0000	— .00000	.00789	+ .00006
3	— .9926	— .00054	.00740	+ .00090
4	— .8302	— .00142	.00915	— .00510
5	— .9876	— .00011	.00896	— .00140
6	— .5536	— .00315	.00908	— .00756
7	— .9430	— .00077	.01396	— .00464
8	— .9189	— .00128	.01640	— .00647
9	— .0929	— .00432	.00872	— .00868
10	— .2784	— .00521	.01130	— .01085
11	— .7960	— .00145	.00790	+ .00478
12	— .9728	— .00046	.01722	— .00399
13	— .3195	— .00658	.01466	— .01389
14	— .7650	— .00183	.00882	+ .00568
15	+ .1362	— .00431	.00879	— .00871
16	— .1115	— .00899	.01820	— .01809
17	— .9990	— .00003	.03698	+ .00164
18	— .2821	— .01323	.02876	— .02759
19	— .7950	— .00459	.02504	+ .01519
20	— .1021	— .01019	.02060	— .02049
21	+ .2578	— .00588	.01260	— .01217
22	— .7722	— .00629	.03125	+ .01985
23	— .4938	— .00550	.01455	+ .01265
24	+ .5728	— .00989	.02941	— .02411
25	— .1043	— .01820	.03680	+ .03660
26	+ .5862	— .00337	.01027	— .00832
27	+ .9366	— .00099	.01612	— .00565
28	+ .9886	— .00021	.01832	— .00276
29	+ .9242	— .00074	.01008	— .00385
30	+ .5519	— .00301	.00866	+ .00722
31	+ .9876	— .00010	.00779	— .00122
32	+ .8784	— .00131	.01147	+ .00548
33	+ .8525	— .00411	.03006	+ .01571
34	+ .9972	— .00017	.06133	+ .00455
35	— .5544	— .00287	.00831	+ .00692
36	— .5975	— .00255	.00793	+ .00636
37	— .9847	— .00024	.01585	— .00276
38	— .9966	— .00003	.00856	— .00070
39	+ .9999	— .00000	.01005	+ .00011
40	+ .9998	— .00000	.01065	+ .00023
41	+ .2210	— .00440	.00925	— .00902
42	+ .1878	— .00443	.00917	— .00901
43	— .0479	— .00452	.00906	— .00905
44	— .2742	— .00383	.00888	+ .00854
45	— .0836	— .00444	.00894	+ .00891
46	— .6957	— .00202	.00784	+ .00563
47	— .9762	— .00021	.00914	+ .00198
48	— .9964	— .00003	.00792	— .00067
49	— .9772	— .00032	.01441	+ .00306
50	— .9674	— .00029	.00900	— .00228
51	— .6360	— .00272	.00915	— .00706
53	— .0821	— .00771	.01554	— .01549
54	+ .7506	— .00406	.01853	+ .01224
56	+ .3680	— .00805	.01862	+ .01731
57	+ .3392	— .00638	.01440	+ .01355
0	+ .7153	— .00348	.01423	+ .00994

Orientation.—The next correction applied is that of orientation. The stars number 9, 14, 16, 18, 19, 25 and 28 were used as standards to determine this correction. The orientation correction would be unnecessary if the telescope had not moved in the least during the formation of the trail, but general experience in observing goes to show that one cannot take this happy condition for granted. Then, too, the measures themselves show that there must be a correction of orientation since the values do not agree as well as might be expected. Again, if we would confine our attention to such stars as are found on all the plates, the mean would probably give us the best value, but in the present series there are but few stars that appear on all the plates. To utilize those that occur on only a few plates it is therefore necessary to have an orientation correction. Furthermore, some of the stars are to be used in determining the parallax. It is evident that the measures would have no value for this purpose if the orientation correction could not be eliminated, or at least reduced to a minimum.

The method used in this paper is that of standard stars. By this method the mean angle is found from suitable stars found on all the plates. Then the variation from this mean will give corrections for the angles. It is evident that such orientation errors as are common to all the plates will not be eliminated by this method.

In selecting the standard stars it must not be forgotten that the angles are affected by both the parallax and the proper motion. Taking for granted that the probable errors of the measures of angles vary inversely as the square of the distance, the effect of parallax will be zero if the following conditions are fulfilled :

$$\frac{\Sigma \sigma^2 S_8}{\Sigma \sigma^2} = 0 \quad \text{and} \quad \frac{\Sigma \sigma^2 S_9}{\Sigma \sigma^2} = 0.$$

The effect of proper motion will be eliminated if we have the condition

$$\Sigma S_7 = 0.$$

In these expressions, according to the notation of former papers published by this observatory, we have

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$$S_5 = \sin (\lambda - \rho)$$

$$S_6 = \frac{1}{\sigma}$$

$$S_7 = S_5 S_6$$

$$S_8 = \frac{f \operatorname{cosec} 1''}{28''.01} S_6 \cos (\pi + F)$$

$$S_9 = \frac{g \operatorname{cosec} 1''}{28''.01} S_6^* \cos (\pi + G).$$

F, G, f, g are determined by the equations

$$g \sin G = \sin \delta \cos a \qquad h \sin H = \sin \delta \sin a$$

$$g \cos G = \sin a \qquad h \cos H = -\cos \delta$$

$$f \sin F = h \sin (H + \varepsilon)$$

$$f \cos F = -\cos a \cos \varepsilon$$

$$a = 0^h 59^m 58^s.12$$

$$\delta = 54^\circ 18' 21''.9$$

We find

$$F = 1^\circ 38' 26''$$

$$G = 71^\circ 48' 19''$$

$$f = -0.8867$$

$$g = 0.8258$$

The number $28''.01$ represents the number of seconds in one division of the scale as found in the Pleiades paper.

TABLE VIII.

Star.	σ	σ^2	S_7	π	$\cos (\pi + F)$	$\cos (\pi + G)$	$\sigma^2 S_8$	$\sigma^2 S_9$
9	114.74	13166	-.00868	210 21' 14"	-.8481	+.2106	+635379.0	+146940.8
14	113.40	12860	+.00568	335 10 34	+.9192	+.6822	-680595.9	+470423.5
16	54.93	3017	-.01809	211 23 7	-.8384	+.2282	+300685.8	+76221.1
18	34.78	1209	-.02759	221 21 5	-.7314	+.3932	+166067.0	+83145.7
19	39.93	1595	+.01519	332 26 43	+.8994	+.7163	-234504.6	+173936.8
25	27.17	738	+.03660	31 12 54	+.8401	-.2253	-149044.2	-37225.7
28	54.60	2981	-.00276	123 42 14	-.5785	-.9636	+205847.5	-319913.9
		35566	+.00035				+243834.6	+593528.3

From the above table we find

$$\frac{\Sigma \sigma^2 S_8}{\Sigma \sigma^2} = +6.85, \quad \frac{\Sigma \sigma^2 S_9}{\Sigma \sigma^2} = +16.7, \quad \Sigma S_7 = +.00035.$$

The orientation correction for each plate as found by these stars is given in Table IX.

TABLE IX.

Plate.	Orient. Correct.	Plate.	Orient. Correct.
31	+1 52	47	-1 2
32	+2 2	48	- 4
33	- 37	49	+ 44
34	+1 10	50	+1 9
36	- 40	51	-1 14
37	+1 15	52	-2 1
38	+ 31	53	-1 15
40	+ 15	54	-2 16
41	+ 8	55	-2 40
42	- 46	56	- 33
43	+ 10	57	+ 39
44	+ 15	58	- 7
45	- 43	59	- 34
46	+3 33	60	-1 16

Parallax.—Since μ Cass. has a considerable parallax it is necessary to correct the distances and the position angles.

The form of the correction for distances is

$$(S_3 P_3 + S_4 P_4) \frac{\pi}{28''.0124},$$

and for the position angles we have

$$(S_8 P_3 + S_9 P_4) \pi,$$

where the parallax (π) is expressed in seconds of arc.

The quantities are all additive.

$$S_3 = f \sin (\rho + F)$$

$$S_4 = g \sin (\rho + G)$$

$$P_3 = -r \sin \odot$$

$$P_4 = -r \cos \odot$$

S_8 and S_9 have same significance as in the discussion under orientation (p. 25).

In column 9, Table XX, we have the factor

$$S_3 P_3 + S_4 P_4$$

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tabulated for every star upon every plate, while in column 9 of Table XXI we have the factor

$$(.S_8 P_3 + S_9 P_1).$$

The quantities P_3 and P_4 are given in Table X; the quantities S_3 , S_4 , S_8 and S_9 in Table XI.

TABLE X.

Plate.	Time.	P_3	P_4
31	1870.559	— .870	— .524
32	1870.559	— .869	— .525
33	1870.578	— .803	— .621
34	1870.578	— .803	— .621
36	1871.523	— .964	— .322
37	1871.523	— .964	— .323
38	1871.559	— .872	— .521
40	1872.005	— .962	— .204
41	1872.005	— .962	— .204
42	1872.014	— .950	— .254
43	1872.549	— .899	— .473
44	1872.549	— .899	— .473
45	1872.552	— .891	— .488
46	1872.552	— .891	— .488
47	1873.016	— .941	— .286
48	1873.025	— .924	— .336
49	1873.025	— .924	— .336
50	1873.027	— .918	— .353
51	1873.536	— .930	— .409
52	1873.553	— .885	— .499
53	1873.553	— .885	— .499
54	1873.559	— .868	— .528
55	1873.559	— .868	— .528
56	1873.559	— .868	— .528
57	1873.964	— .983	— .045
58	1873.964	— .983	— .045
59	1873.973	— .983	— .006
60	1873.973	— .983	— .006

In correcting the coördinates for parallax, the assumed value $0''.25$ was used. This is a little smaller than the value found by Professor Harold Jacoby (5, p. 9), but larger than that found by other astronomers.

TABLE XI.—FOR PARALLAX.

Star.	S_3 $f \sin (\phi + F)$	S_4 $g \sin (\phi + G)$	S_5	S_6
1	+.826	-.543	- 18.724	36.191
2	+.789	+.104	- 23.500	47.648
3	+.738	.198	- 26.791	43.688
4	+.880	-.376	- 7.598	40.800
5	+.845	-.031	- 17.810	54.688
6	-.770	-.628	+ 29.475	35.873
7	+.880	-.180	- 11.499	83.077
8	-.885	-.233	- 6.424	95.663
9	+.470	-.808	- 48.160	11.152
10	+.603	-.761	- 54.109	26.825
11	+.388	-.576	- 46.355	34.466
12	-.863	-.094	- 25.829	103.907
13	-.807	-.746	67.549	38.379
14	-.348	-.604	- 52.814	36.510
15	-.286	-.826	- 54.376	0.926
16	+.483	-.804	99.626	25.254
17	+.773	+.135	-118.082	221.047
18	+.605	-.759	- 137.568	68.823
19	+.388	-.576	-146.823	108.889
20	+.314	-.826	-125.756	2.042
21	-.180	-.818	- 80.555	10.826
22	-.356	+.598	-180.433	130.828
23	+.043	+.762	- 95.210	34.232
24	-.129	-.728	-189.901	84.409
25	-.481	.804	-201.827	50.302
26	-.142	-.722	- 66.375	30.426
27	-.603	-.379	- 77.104	86.063
28	-.724	-.220	69.084	107.237
29	-.580	-.404	- 49.867	53.559
30	-.770	-.629	- 28.242	34.259
31	-.719	-.225	29.736	45.617
32	-.887	+.305	- 2.395	64.683
33	-.884	+.343	- 16.115	166.481
34	-.819	-.038	-153.009	372.333
35	-.771	+.628	- 26.830	32.770
36	-.793	+.599	- 23.128	33.078
37	-.710	-.239	61.679	91.024
38	-.756	-.165	- 29.265	51.227
39	-.796	-.090	29.009	61.046
40	-.801	-.081	- 29.766	64.146
41	-.212	-.822	58.313	5.801
42	+.242	-.824	57.790	3.916
43	-.435	-.814	+ 51.744	9.230
44	-.166	-.816	- 57.060	8.432
45	-.331	+.825	- 53.902	1.681
46	+.264	+.658	- 48.625	28.633
47	+.686	+.274	- 37.579	52.101
48	+.823	+ .029	- 19.172	48.008
49	+.689	+.271	- 50.223	82.710
50	+.867	-.112	- 12.199	54.212
51	+.811	-.571	+ 24.357	40.407
53	+.459	-.810	- 86.597	18.520
54	-.857	+.466	- 30.269	92.885
56	-.664	+.724	- 80.552	54.164
57	-.645	+.737	- 64.478	39.560
θ	-.845	-.501	- 28.008	68.575

III. PARALLAX.

General Statement.—The photographic method has produced results, in the field of parallax, which compare very favorably with the results obtained by other methods. The work already done at this observatory (5, 12, 13) has demonstrated that the Rutherford plates may be relied upon. It is true, the results obtained thus far have been somewhat large, and yet not so large as to be out of all comparison with the values as obtained by the heliometer. Furthermore, they are determined with the same degree of accuracy which is to be obtained by other methods.

After reducing the distances and position angles for the stars about μ Cass. the data is all ready to find the parallax. Professor Jacoby has already solved this problem by the use of distances. But the position angles have not yet been used. A determination of the parallax by position angles would therefore be entirely independent of the value already found by distances. At the same time it would be quite a reliable criterion as to the weight to be given the value already found. Furthermore, if the two values agree it would go to show that the position angles—although not as accurate as the distances—are sufficiently accurate to solve the delicate problem of parallax. This fact once established would be of considerable value since then any series of plates would furnish much more data than if we confined ourselves to the distances. Another fact in favor of the position angles is this: each star gives a separate and independent determination of the parallax, while it takes two stars to give an independent determination if the distances are used. Not only this, but these two stars must be selected so as to fulfill certain simple requirements. All in all, we have much greater freedom when dealing with the position angles than when dealing with the distances.

The work of Dr. Davis (13) has already shown that the position angle may be used with profit. For 61¹ Cygni he obtained the following results: five independent determinations by *distances* gave

$$+ 0''.3999 \pm 0''.0230,$$

while seven independent determinations by position angles gave

$$+ 0''.3326 \pm 0''.0189.$$

The above results compare very favorably. The results obtained by position angles seem to be even better than those obtained by distances.

In the present paper eleven independent determinations were made with the hope of adding something to our knowledge of the parallax of μ and also for the purpose of comparing the results with the values found by Professor Jacoby (5).

The general form of the equation of condition to solve for parallax is

$$x + ay + b\Pi + n = 0$$

where a depends upon the time, and b is equal to $S_8P_3 + S_9P_4$ and has the same meaning as in the discussion under *Parallax Correction*. This coefficient is tabulated in column 9 of Table XXI.

n is the variation from the mean.

Comparison Stars.—In selecting the comparison stars it was remembered that they should be symmetrically distributed with reference to μ . By this means certain errors, which might possibly be introduced from some unknown source, would probably be eliminated from the mean. A comparison of the chosen stars, however, shows that they are not as symmetrically distributed as might have been desired.

The following is the chosen list :

It will be noticed that θ is not included. It would be possible to find the parallax of θ by making a determination with θ as the comparison star and assuming the value for the parallax of μ as found from the other stars. But an examination of the parallax coefficient as tabulated in column 9, Table XXI, shows that θ is

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TABLE XII.

No.	Dis. (d)	Pos. Ang. (p)
8	61	272°
10	88	221
14	113	335
16	55	211
18	35	221
19	40	332
20	48	199
25	27	31
26	97	169
28	55	124
32	87	87

poorly situated for this purpose. It was thought best, therefore, not to use it as no value is to be preferred to a poor value.

Equations of Condition.—The position angles used in obtaining the absolute term in the following equations are those given in column 8, of Table XXI. They are the angles to which all the corrections have been applied with the exception of that depending upon the parallax.

The coefficient of y varies uniformly with the time.

PARALLAX EQUATIONS.—STAR 8.

					Residuals.	
1.00 x	—1.44 y	+56 Π	+10	= 0	+27	+.22
1.00	—1.44	+56	—97		—80	— .66
1.00	—1.42	+64	—13		+5	+.04
1.00	—1.42	+64	+0		+18	+.14
1.00	— .44	+55	—8		+3	+.02
1.00	+ .00	—26	—20		—24	— .19
1.00	+ .00	—26	+15		+11	+.09
1.00	+ .01	—30	+30		+25	+.20
1.00	+ .55	+51	—7		—1	— .01
1.00	+ .55	+51	—17		—11	— .09
1.00	+ .55	+52	+32		+38	+.32
1.00	+ .55	+52	—10		—4	— .03
1.00	+1.02	—33	—10		—21	— .17
1.00	+1.02	—38	+31		+19	+.15
1.00	+1.02	—38	+26		+14	+.12
1.00	+1.03	—39	+31		+19	+.16
1.00	+1.54	+45	+5		+5	+.04
1.00	+1.55	+53	+23		+24	+.20
1.00	+1.96	—2	+10		+0	— .00
1.00	+1.96	—2	—20		—30	— .25
1.00	+1.97	—7	—5		—16	— .13
1.00	+1.97	—7	—11		—22	— .18

Normal Equations.

$$\begin{aligned}
 22.0000x + 11.0900y + 351.00\Pi - 5.0000 &= 0 \\
 +33.9849y - 289.56\Pi + 218.56 &= 0 \\
 +40789.00\Pi - 8463.00 &= 0
 \end{aligned}$$

Solution in angle.

In arc of great circle.

$$\Pi = 0^{\circ}.1726 \pm 0.1104$$

$$y = -4.9510 \pm 3.884$$

$$x = -0.0307 \pm 5.038$$

$$\text{or } -0.0411 \pm 0.0322$$

$$\text{or } -0.0002 \pm 0.0418$$

$$[\nu\nu] = 13991$$

$$\sigma = 60.9665$$

$$\text{Factor} = .0083$$

$$\text{Mean error of obs. } \epsilon = 27.14$$

PARALLAX EQUATIONS.—STAR 10.

					Residuals.	
1.00x	-1.44y	-33II'	- 3	0	9	-.11
1.00	-1.44	-33	+24		36	+.43
1.00	-1.42	-27	+ 3		-15	-.18
1.00	-1.42	-27	-44		-32	-.38
1.00	- .44	-33	-24		-18	-.22
1.00	+ .00	+.47	+16		-20	-.24
1.00	.00	+.47	-20		-16	-.19
1.00	.01	+.44	- 4		- 0	+.00
1.00	.55	-35	-10		-10	-.12
1.00	1.02	+.43	-12		-15	-.18
1.00	1.02	+.50	-15		-18	-.22
1.00	1.03	+.41	- 5		- 8	-.10
1.00	1.54	-39	+ 4		- 4	-.05
1.00	1.55	-34	+17		+10	+.12
1.00	1.96	+.54	+48		+.39	+.47
1.00	1.96	+.54	+11		+ 2	+.02
1.00	1.97	+.53	- 4		-13	-.16
1.00	+1.97	+.53	+15		+ 6	+.07

Normal Equations.

$$\begin{aligned} 18.00x + 8.4200y + 2.2500\Pi' - 3.0000 &= 0 \\ + 32.0370y + 6.1226\Pi' + 170.1300 &= 0 \\ + 3.2461\Pi' + 27.5600 &= 0 \end{aligned}$$

Solution.

$$\Pi = 0.0147 \pm .0944$$

$$y = -6.3700 \pm 3.103 \quad \text{or} \quad -.0764 \pm .0372$$

$$x = 2.9626 \pm 0.876 \quad \text{or} \quad +.0355 \pm .0105$$

$$[\nu\nu] = 6165$$

$$\sigma = 88.5087$$

$$\text{Factor} = 0.120$$

$$\text{Mean error of obser. } \epsilon = 20.27$$

PARALLAX EQUATIONS.—STAR 14.

					Residuals.	
1.00x	—1.44y	+ 65II	—17	= 0	— 1	— .02
1.00	—1.44	+ 65	— 9		+ 7	+ .11
1.00	—1.42	+ 65	—22		— 6	— .09
1.00	—1.42	+ 65	+ 0		+16	+ .25
1.00	— .48	+ 63	+14		+26	.40
1.00	— .44	+ 65	+ 2		+14	+.22
1.00	+ .00	— 58	+54		+47	+.72
1.00	.00	— 58	—26		—33	— .51
1.00	.01	— 59	—13		—20	— .31
1.00	.55	+ 65	—11		— 4	— .06
1.00	.55	+ 65	—32		—25	— .38
1.00	.55	+ 65	—23		—16	— .25
1.00	.55	+ 65	—12		— 5	— .08
1.00	1.02	— 60	—24		—36	— .55
1.00	1.02	— 61	+13		+ 1	+.02
1.00	1.02	— 61	+ 8		— 4	— .06
1.00	1.03	— 61	—11		—23	— .35
1.00	1.54	+ 64	—32		—29	— .45
1.00	1.55	+ 65	— 8		— 5	— .08
1.00	1.55	+ 65	—10		— 7	— .11
1.00	1.56	+ 65	+12		+14	+.22
1.00	1.56	+ 65	— 8		— 6	— .09
1.00	1.56	+ 65	+20		+22	+.34
1.00	1.96	— 50	+30		+15	+.23
1.00	1.96	— 50	+16		+ 1	+.02
1.00	1.97	— 52	+45		+30	+.46
1.00	+1.97	— 52	+48		+33	+.51

Normal Equations.

$$\begin{aligned}
 27.0000x + 16.8400y + 415.00II + 4.00 &= 0 \\
 + 43.9186y - 333.32II + 237.29 &= 0 \\
 + 102595.00II - 15999.00 &= 0
 \end{aligned}$$

Solution.

$$\begin{aligned}
 II &= 0.1388 \pm .0504 \\
 y &= -4.5692 \pm 2.710 \quad \text{or} \quad -.0694 \pm .0417 \\
 x &= 0.5683 \pm 3.522 \quad \text{or} \quad .0088 \pm .0542 \\
 [vv] &= 11522 \\
 \sigma &= 113.3964 \\
 \text{Factor} &= .0154 \\
 \varepsilon &= 21.91
 \end{aligned}$$

PARALLAX EQUATIONS, — STAR 16.

					Residuals.	
1.00 x	—1.44 y	—73 Π'	+ 4	= 0	—12	—03
1.00	1.44	—73	— 3		—19	—14
1.00	1.42	—64	+55		+42	+32
1.00	1.42	—64	+27		+14	+10
1.00	.48	—88	+ 4		—17	—13
1.00	.48	—88	+39		+18	+13
1.00	— .44	—73	+ 2		—15	—11
1.00	+ .00	+91	—51		—24	—18
1.00	.00	+91	—69		—42	—32
1.00	.01	+88	—28		— 2	—02
1.00	.55	—78	+24		+ 4	+03
1.00	.55	—78	+57		+37	+28
1.00	.55	—76	+13		— 6	—04
1.00	.55	—76	+45		+26	+20
1.00	1.02	+86	— 9		+15	+11
1.00	1.02	+84	+27		+51	+38
1.00	1.02	+84	—56		—32	—24
1.00	1.03	+83	—26		— 3	—02
1.00	1.54	—82	+18		— 4	—03
1.00	1.55	—76	—18		—38	—28
1.00	1.55	—76	—18		—38	—28
1.00	1.56	—73	+34		+14	+10
1.00	1.96	+99	—37		—11	—08
1.00	1.96	+99	— 5		+21	+16
1.00	1.97	+98	—32		— 7	—05
1.00	+1.97	+98	+ 5		+30	+22

Normal Equations,

$$\begin{aligned}
 26.00x + 13.2400y - 1.3700\Pi' + 2.0000 &= 0 \\
 +39.2818y + 9.8309\Pi' - 239.32 &= 0 \\
 +17.8505\Pi' - 467.55 &= 0
 \end{aligned}$$

Solution.

$$\begin{aligned}
 \Pi &= 0.2711 + .0473 \\
 y &= -1.3870 \pm 3.4919 \quad \text{or} \quad -.0104 \pm .0262 \\
 x &= 2.0581 \pm 3.992 \quad \text{or} \quad .0154 \pm .0300 \\
 [vv] &= 16214 \\
 \sigma &= 54.9281 \\
 \text{Factor} &= .0075 \\
 \varepsilon &= 26.55
 \end{aligned}$$

PARALLAX EQUATIONS.—STAR 18.

Residuals.

1.00x	—1.44y	— 84II	+ 33	= 0	+ 36	+.17
1.00	1.44	— 84	— 24		— 21	— .10
1.00	1.42	— 67	+ 29		+ 35	+.16
1.00	1.42	— 67	— 2		+ 4	+.02
1.00	.48	—110	— 18		— 32	— .15
1.00	— .44	— 84	—109		—117	— .54
1.00	+ .00	+118	— 49		— 21	— .10
1.00	.00	+118	— 13		+ 15	+.07
1.00	.01	+113	+ 8		+ 35	+.16
1.00	.55	— 91	+ 8		— 13	— .06
1.00	.55	— 91	+ 54		+ 33	+.16
1.00	.55	— 89	+ 33		+ 13	+.06
1.00	.55	— 89	+ 24		+ 4	+.02
1.00	1.02	+110	— 1		+ 14	+.07
1.00	1.02	+104	— 66		— 53	— .25
1.00	1.02	+104	+ 33		+ 46	+.22
1.00	1.03	+102	+ 33		+ 46	+.22
1.00	1.54	—100	+ 52		+ 17	+.08
1.00	1.55	— 87	+ 78		+ 46	+.22
1.00	1.55	— 87	+ 22		— 10	— .05
1.00	1.96	+138	— 11		— 1	— .00
1.00	1.96	+138	— 8		+ 2	+.00
1.00	1.97	+135	— 46		— 36	— .17
1.00	+1.97	+135	— 52		— 42	— .20

Normal Equations.

$$\begin{aligned}
 24.00x + 12.1600y + 185.0000II + 8.00 &= 0 \\
 + 36.6178y + 1403.6700II + 74.92 &= 0 \\
 + 259079.11 - 38484.00 &= 0
 \end{aligned}$$

Solution.

$$\begin{aligned}
 II &= 0.2066 \pm .0604 \\
 y &= -11.2127 \pm 5.5484 \quad \text{or} \quad -.0527 \pm .0261 \\
 x &= 3.7552 \pm 6.1116 \quad \text{or} \quad .0176 \pm .0288 \\
 [vv] &= 33832 \\
 \sigma &= 34.7744 \\
 \text{Factor} &= .0047 \\
 \varepsilon &= 40.14
 \end{aligned}$$

PARALLAX EQUATIONS.—STAR 19.

					Residuals.	
1.00 x	$-1.44 y$	$+1.85 \Pi'$	-11	$=0$	-43	$-.23$
1.00	1.44	$+1.85$	$+36$		$+4$	$+.02$
1.00	1.42	$+2.00$	-24		-52	$-.28$
1.00	1.42	$+2.00$	-30		-58	$-.31$
1.00	$-.48$	$+1.77$	$+32$		-33	$+.18$
1.00	$+.00$	-1.63	$+73$		$+16$	$+.09$
1.00	.00	-1.63	$+75$		$+18$	$+.10$
1.00	.01	-1.67	$+48$		-10	$-.05$
1.00	.55	$+1.83$	-13		$+26$	$+.14$
1.00	.55	$+1.83$	-30		-9	$+.05$
1.00	.55	$+1.84$	-36		$+4$	$+.02$
1.00	.55	$+1.84$	-52		-12	$-.06$
1.00	1.02	-1.69	$+45$		$+24$	$+.13$
1.00	1.02	-1.72	$+109$		$+87$	$+.47$
1.00	1.02	-1.72	$+144$		$+122$	$+.66$
1.00	1.03	-1.73	$+97$		$+75$	$+.40$
1.00	1.54	$+1.81$	-4		-70	$+.38$
1.00	1.55	$+1.84$	-20		-56	$+.30$
1.00	1.96	-1.40	-72		-53	$-.29$
1.00	1.96	-1.40	-108		-89	$-.48$
1.00	1.97	-1.45	-110		-92	$-.50$
1.00	$+1.97$	-1.45	-149		-131	$-.71$

Normal Equations.

$$\begin{aligned}
 22.00x + 11.0500y + 2.9700\Pi' + 0.0000 &= 0 \\
 +34.0217y - 20.4134\Pi' - 542.57 &= 0 \\
 +66.1021\Pi' - 662.63 &= 0
 \end{aligned}$$

Solution.

$$\begin{aligned}
 \Pi &= 0.2211 \pm .0640 \\
 y &= 36.067 \pm 9.733 \quad \text{or} \quad .1948 \pm .0526 \\
 x &= -21.1003 \pm 10.940 \quad \text{or} \quad -.1139 \pm .0591 \\
 [pv] &= 83664 \\
 \sigma &= 39.9358 \\
 \text{Factor} &= .0054 \\
 \varepsilon &= 66.36
 \end{aligned}$$

PARALLAX EQUATIONS.—STAR 20.

Residuals.

1.00x	—1.44y	—1.08II'	+ 0	= 0	—11	—07
1.00	1.44	—1.08	+10		— 1	—01
1.00	1.42	—1.00	+63		+54	+36
1.00	1.42	—1.00	—22		—31	—20
1.00	.48	—1.21	+18		— 8	—05
1.00	.48	—1.21	+38		+12	+08
1.00	— .44	—1.09	+36		+14	+09
1.00	+ .00	+1.21	—20		+23	+15
1.00	.60	+1.21	—95		—52	—34
1.00	.01	+1.19	—13		+29	+19
1.00	.55	—1.12	+33		+ 0	+00
1.00	.55	—1.11	— 1		—34	—22
1.00	.55	—1.11	+43		+10	+07
1.00	1.02	+1.18	—60		—28	—18
1.00	1.02	+1.16	—14		+17	+11
1.00	1.02	+1.16	—58		—27	—18
1.00	1.03	+1.15	—42		— 9	—06
1.00	1.54	—1.16	+71		+26	+17
1.00	1.55	—1.11	+31		—13	—08
1.00	1.55	—1.11	+27		—17	—11
1.00	1.96	+1.24	—35		—11	—07
1.00	1.96	+1.24	—24		+ 0	+00
1.00	1.97	+1.24	— 3		+21	+14
1.00	1.97	+1.24	+16		+40	+26

Normal Equations.

$$\begin{aligned}
 24.00x + 11.1300y - 1.1700II' - 1.00 &= 0 \\
 +36.5457y + 15.0400II' - 142.91 &= 0 \\
 +31.8783II' - 803.40 &= 0
 \end{aligned}$$

Solution.

$$\begin{aligned}
 II &= 0.3042 \pm 0.0366 \\
 y &= -10.56 \pm 3.690 \quad \text{or} \quad -0.0707 \pm 0.0244 \\
 x &= 6.422 \pm 4.081 \quad \text{or} \quad +0.0414 \pm 0.0269 \\
 [vv] &= 14892 \\
 \sigma &= 48.5499 \\
 \text{Factor} &= .0066 \\
 \varepsilon &= 26.63
 \end{aligned}$$

PARALLAX EQUATIONS.—STAR 25.

					Residuals.	
1.00x	—1.44y	+1.49Π'	+ 32	= 0	+47	+.17
1.00	1.44	+1.49	— 4		+11	+.04
1.00	1.42	+1.31	— 70		—58	— .21
1.00	1.42	+1.31	+ 13		+57	+.21
1.00	.48	+1.78	— 15		+12	+.04
1.00	.48	+1.78	— 74		—47	— .17
1.00	— .44	+1.50	+ 73		+95	+.35
1.00	+ .00	—1.84	+ 34		—13	— .05
1.00	.00	—1.84	+ 91		+44	+.16
1.00	.01	—1.79	— 2		—48	— .18
1.00	.55	+1.58	— 23		+ 6	+.02
1.00	.55	+1.58	— 91		—62	— .23
1.00	.55	+1.55	+ 14		+43	+.16
1.00	.55	+1.55	— 61		—32	— .12
1.00	1.02	—1.76	+ 7		—31	— .11
1.00	1.02	—1.70	+ 35		— 2	— .01
1.00	1.02	—1.70	— 29		—66	— .24
1.00	1.03	—1.67	+ 10		—26	— .10
1.00	1.54	+1.67	— 57		—20	— .07
1.00	1.55	+1.54	— 37		— 2	— .01
1.00	1.55	+1.54	— 37		— 2	— .01
1.00	1.56	+1.48	— 32		+ 1	+.00
1.00	1.56	+1.48	+ 47		+80	+.30
1.00	1.56	+1.49	—116		—82	— .30
1.00	1.96	—2.01	+ 41		+ 3	+.01
1.00	1.96	—2.01	+ 43		+ 5	+.02
1.00	1.97	—1.98	+105		+68	+.25
1.00	+1.97	—1.98	+ 90		+53	+.20

Normal Equations,

$$\begin{aligned}
 28.00x + 16.3600y + 5.8400\Pi' - 13.00 &= 0 \\
 +44.1490y - 15.3312\Pi' + 174.96 &= 0 \\
 +77.9528\Pi' - 1515.21 &= 0
 \end{aligned}$$

Solution.

$$\begin{aligned}
 \Pi &= 0.2123 \pm .0400 \\
 y &= +6.2263 \pm 5.949 \quad \text{or} \quad .0230 \pm .0220 \\
 x &= -7.6016 \pm 8.627 \quad \text{or} \quad -.0281 \pm .0319 \\
 [vv] &= 58480 \\
 \sigma &= 27.1751 \\
 \text{Factor} &= .0037 \\
 \varepsilon &= 48.36
 \end{aligned}$$

PARALLAX EQUATIONS.—STAR 26.

Residuals.

I.00x	—1.44y	—74Π'	+37 = 0	+37	+49
I.00	I.44	—73	+17	+17	+22
I.00	I.42	—72	+15	+15	+20
I.00	I.42	—72	—50	—50	—66
I.00	.48	—74	+5	—4	—05
I.00	.48	—74	+11	+2	+03
I.00	— .44	—74	+29	+20	+26
I.00	+ .00	+70	—38	—5	—07
I.00	.00	+70	—95	—62	—82
I.00	.01	+71	—25	+9	+12
I.00	.55	—74	+15	—4	—05
I.00	.55	—74	+53	+34	+45
I.00	.55	—74	+28	+9	+12
I.00	.55	—74	+21	+2	+03
I.00	I.02	+71	—23	+2	+03
I.00	I.02	+73	—40	—15	—20
I.00	I.02	+72	—20	+5	+07
I.00	I.03	+72	—36	—11	—14
I.00	I.54	—74	+6	—22	—29
I.00	I.55	—74	—10	—38	—50
I.00	I.56	—74	+42	+13	+17
I.00	I.56	—74	—1	—30	—40
I.00	I.56	—74	+29	+0	+00
I.00	I.96	+64	+1	+14	+18
I.00	I.96	+64	+2	+15	+20
I.00	I.97	+66	+15	+29	+38
I.00	+1.97	+66	+10	+24	+32

Normal Equations.

$$\begin{aligned}
 27.00x + 14.8100y - 4.2000\Pi' - 2.00 &= 0 \\
 +41.7465y + 5.8809\Pi' + 51.93 &= 0 \\
 +13.9368\Pi' - 361.59 &= 0
 \end{aligned}$$

Solution.

$$\begin{aligned}
 \Pi &= 0''.3320 \pm .0505 \\
 y &= -9.6590 \pm 3.177 \quad \text{or} \quad -.1275 \pm .0419 \\
 x &= 10.5366 \pm 3.932 \quad \text{or} \quad .1391 \pm .0519 \\
 [vv] &= 15220 \\
 \sigma &= 97.3704 \\
 \text{Factor} &= .0132 \\
 \varepsilon &= 25.18
 \end{aligned}$$

PARALLAX EQUATIONS.—STAR 28.

					Residuals.	
1.00x	-1.44y	-1.16II'	+ 21	= 0	+17	+13
1.00	1.44	-1.16	+ 4		+ 0	+ .00
1.00	1.42	-1.22	+ 18		+13	+10
1.00	1.42	-1.22	- 4		- 9	-.07
1.00	.48	-1.01	+ 3		- 4	-.03
1.00	.48	-1.01	+ 13		+ 6	+ .04
1.00	- .44	-1.16	+ 16		+ 4	+ .03
1.00	+ .00	+ .88	- 68		-34	-.25
1.00	.00	+ .88	- 32		+ 2	+ .01
1.00	.01	+ .93	+ 8		+43	+ .32
1.00	.55	-1.13	+ 2		-16	-.12
1.00	.55	-1.13	+ 65		+47	+ .35
1.00	.55	-1.14	+ 3		-15	-.11
1.00	.55	-1.14	+ 31		+13	+ .10
1.00	1.02	+ .96	- 18		+10	+ .07
1.00	1.02	+ 1.00	-100		-71	-.52
1.00	1.02	+ 1.00	- 57		-28	-.21
1.00	1.03	+ 1.01	- 59		-30	-.22
1.00	1.54	-1.08	+ 14		-11	-.08
1.00	1.55	-1.15	+ 13		-13	-.10
1.00	1.55	-1.15	+ 30		+ 4	+ .03
1.00	1.56	-1.16	+ 17		-10	-.07
1.00	1.56	-1.16	- 37		-64	-.47
1.00	1.56	-1.16	+ 47		+20	+ .15
1.00	1.96	+ .63	+ 23		+36	+ .27
1.00	1.96	+ .63	+ 13		+26	+ .19
1.00	1.97	+ .67	+ 13		+27	+ .20
1.00	+ 1.97	+ .67	+ 26		+40	+ .30

Normal Equations.

$$\begin{aligned}
 28.00x + 16.3600y - 10.0800II' + 5.0000 &= 0 \\
 +44.1490y + 4.3098II' + 23.4800 &= 0 \\
 +30.1020II' - 556.7800 &= 0
 \end{aligned}$$

Solution.

$$\begin{aligned}
 II &= 0''.2391 \pm 0.418 \\
 y &= -7.6457 \pm 3.649 \quad \text{or} \quad -.0566 \pm .0270 \\
 x &= 12.8987 \pm 4.863 \quad \text{or} \quad .0954 \pm .0360 \\
 [vv] &= 22503 \\
 \sigma &= 54.5999 \\
 \text{Factor} &= .0074 \\
 \varepsilon &= 30.
 \end{aligned}$$

PARALLAX EQUATIONS.—STAR 32.

				Residuals.	
1.00 ν	—1.44 ν	— .32 Π'	— .19 — 0	+33	+.39
1.00	1.44	— .32	+ 3	+17	+.20
1.00	1.42	— .38	—24	—12	— .14
1.00	1.42	— .38	+10	+22	+.26
1.00	— .44	— .32	—58	—53	— .62
1.00	+ .00	+ .11	—19	—13	— .15
1.00	.01	+ .14	—26	—19	— .22
1.00	.55	— .30	— 1	— 5	— .06
1.00	.55	— .30	+17	+13	+.15
1.00	1.02	+ .16	+ 0	— 2	— .02
1.00	1.02	+ .20	—35	—36	— .42
1.00	1.03	+ .21	+35	+34	+.40
1.00	1.54	— .24	—28	—39	— .46
1.00	1.55	— .30	+ 9	— 3	— .04
1.00	1.96	— .01	+33	+21	+.25
1.00	1.97	— .02	+31	+19	+.22
1.00	+1.97	— .02	+38	.26	+.31

Normal Equations.

$$\begin{aligned}
 17.00x + 7.0100y - 2.0900\Pi' + 4.0000 &= 0 \\
 +28.4979y + 1.4635\Pi' + 194.0500 &= 0 \\
 +1.0659\Pi' + 8.9700 &= 0
 \end{aligned}$$

Solution.

$$\begin{aligned}
 \Pi &= 0''.1340 \pm .2455 \\
 y &= -8.7311 \pm 4.344 \quad \text{or} \quad -1.030 \pm .0512 \\
 x &= +5.0124 \pm 6.219 \quad \text{or} \quad .0591 \pm .0734 \\
 [v] &= 11003. \\
 \sigma &= 87.2006 \\
 \text{Factor} &= .0118 \\
 \varepsilon &= 28.04
 \end{aligned}$$

Table of Parallax.—The different values of the parallax have been brought together with their probable errors, the weight of each and the residuals.

The final value is the weighted mean. The probable error was found by the formula

$$r_0 = .6745 \sqrt{\frac{[\rho\nu\nu]}{(n-1)[\rho]}}$$

TABLE XIII.

No. of Stars.	Parallax.	wt	ν	$p\nu\nu$	s	p
8	0.173 $\pm$ 0.110	82	— .065	.355	61 ^d	272°
10	0.015 $\pm$ 0.094	112	— .223	5.605	88	221
14	0.139 $\pm$.050	394	— .099	3.908	113	335
16	0.271 $\pm$.047	447	+ .033	.478	55	211
18	0.207 $\pm$.060	274	— .031	.277	35	221
19	0.221 $\pm$.064	244	— .017	.073	40	332
20	0.304 $\pm$.037	746	+ .066	3.230	48	199
25	0.212 $\pm$.040	625	— .026	.426	27	31
26	0.332 $\pm$.050	392	+ .094	3.434	97	169
28	0.239 $\pm$.042	572	+ .001	.000	55	124
32	0.134 $\pm$.246	16	— .104	.174	87	87

Final value, weighted mean, $\Pi = 0''.238 \pm 0.014$.

Discussion.—An examination of the table shows that the various values agree very well *inter se*, with the exception of that found from star number 10. But the weight of the parallax as obtained from this star is comparatively small, being only about $\frac{1}{6}$ or $\frac{1}{7}$ of that of some of the other stars.

If the three stars with the least weight are omitted the result will not be affected materially. We then have

$$0''.247 \pm 0''.014$$

as our final value, instead of

$$0''.238 \pm 0''.014$$

We may explain the small parallax obtained from star 10 by assuming this star to have a parallax of its own. It is true, the star is faint and so, generally speaking, we would not expect to find a parallax. On the other hand, it would not be strange to find one star among the eleven used as comparisons, with a parallax of its own. There is nothing in the constitution of the heavens which requires all the faint stars to be much farther removed than the brighter ones. When we remember that there are several stars in Cassiopeiæ which have a considerable parallax, the consideration gains weight. Why can not this star belong to the group to which μ , θ and η belong? This point can be finally decided by finding the parallax of this star by inde-

pendent measurements. Until that is done, this can only be a conjecture.

For the present all the stars have been included in finding the mean. This gives, as already stated

$$\Pi = 0''.238 \pm 0''.014$$

as the final value.

This agrees very well with the results of Professor Jacoby as found by the use of distances. His determinations gave (5, p. 9)

$$\begin{aligned}\Pi &= 0''.249 \pm 0''.045 \\ &= 0.265 \pm 0.035 \\ &= 0.324 \pm 0.050\end{aligned}$$

The mean, by weight, of these three values gives

$$\Pi = 0''.275 \pm 0''.024.$$

We see then that the two methods give results which agree very well. This comparison, together with that of Dr. Davis (13, p. 155) to which reference has already been made, puts the method of position angle on a par with the method of distances when photographic plates are used. This is rather a remarkable result when we think of the inaccuracy with which position angles are measured. And yet the result is borne out by eighteen independent determinations, seven of which were made by Dr. Davis.

In Table XIII we have tabulated the distances and the position angles of the stars of reference. An examination of the values of the parallax shows that they do not vary with the distances nor with the position angle. This is as it should be if there is no unknown source of error which depends upon either one of these coördinates. There seems to be no such error.

Residuals Investigated.—It may be profitable to spend a few moments examining the residuals of the equations of condition. They have all been reduced to seconds of arc by the use of the "factor" given with each set of equations. It will be seen, first of all, that no single residual has as great a value as 1'' of arc. The largest value is $-0''.82$ which belongs to star 26.

Taking account of the sign, the residuals of no star vary as much as $1''.5$. Of the eleven stars used for finding the parallax, four show a variation of over $1''$ of arc. The maximum value of the variation of the residuals is $1''.37$.

The number of times the sign of the residuals varies is about as great as might be expected. The least number of changes occurs in connection with star 10 which has but 6 changes. But it must be noted that for this star we have but 18 equations of condition, making 17 the greatest number of changes possible.

The greatest consecutive number of like signs occurs in the residuals of star 25 where we have eight negative residuals following each other. But it may be noticed that these residuals are small, no less than three being but $0''.01$. Then again, these residuals are not all confined to the observations made in any one period of the star's maximum, but cover three such periods.

A study of the residuals shows that there is probably no systematic error affecting our observations. They are as small as may well be desired and are distributed as uniformly as regards sign as might be expected.

For convenience of discussion and comparison a small table has been made giving in the

1st column the number of the star; in the

2d, the number of changes of signs in the residuals; in the

TABLE XIV.

Star.	No. of Changes.			No of Obs.	Greatest +	Greatest --	Variation.
8	9	5	2	22	.32	.66	.98
10	6	5	2	18	.47	.38	.85
14	9	7	3	27	.72	.55	1.27
16	13	5	2	26	.38	.32	.70
18	9	4	2	24	.22	.54	.76
19	8	6	2	22	.66	.71	1.37
20	13	3	2	24	.36	.34	.70
25	14	8	3	28	.35	.30	.65
26	12	4	1	27	.49	.82	1.31
28	12	5	2	28	.35	.52	.87
32	8	4	3	17	.42	.62	1.04

3d, the greatest number of times the same sign occurs in succession ; in the

4th, the number of corresponding parallax maxima ; the

5th, number of equations of condition ; in the

6th, the greatest positive residual ; in the

7th, the greatest negative residual ; in the

8th, the variation.

Historical.—In a letter dated November 13, 1816, Bessel (22, p. 245) writes to Gauss saying: “Die Einleitung handelt, wie sie bemerken werden, von der Parallaxe der beiden Sterne 61 Cygni und μ . Cassiopejæ, die ich ganz unbemerktlich oder sogar kleiner finde als die der benachbarten Sterne. Doch bin ich weit entfernt, auf dieses Resultat Gewicht zu legen . . .” Bessel compared μ Cassiopeiæ with θ , and since θ itself has quite a parallax the result could not be other than indicated in the letter just quoted. Later reductions have shown that Bessel’s surmise was well founded when he refused to give his value much weight. Bessel’s observations were re-reduced by Dr. Davis. By employing the Auwers’ proper motions of the two stars Dr. Davis found $+0.02 \pm 0.24$ as the difference of the parallax of μ and θ .

If we assume the parallax of θ to be $0''.23$, as found by Professor Jacoby, we have quite a large parallax for μ . These considerations transform Bessel’s result from $-0''.12$ into $+0''.25$.

TABLE XV.

Authority.	Method.	Value with Prob. Error.
Bessel (14, p. 216)	Diff. R. A.	$-0''.12 \pm 0.29$
Bessel re-reduced by Davis (15, p. 75)		$+0.02 \pm 0.24$
O. Struve (16)	Distance.	$+0.251 \pm .075$
	Pos. Ang.	$+0.425 \pm .072$
Schweizer (17)	Micrometer.	$+0.084 \pm .060$
Pritchard (18)	Phot.	$+0.051 \pm .027$
		$+0.021 \pm .023$
Jacoby (5, p. 9)	Phot. Dis.	$+0.275 \pm .024$
Peter (19, p. 199)	Heliometer Dis.	$+0.12 \pm .022$
Bauer	Phot. Pos. Ang.	$+0.238 \pm .014$

To Eliminate Orientation.—Orientation plays a very important part in determining the parallax. The position angles of one plate must be compared with the corresponding position angles as found upon the other plates. If there is an error in the orientation which is not common to all the plates, the parallax will be affected. It is of prime importance, then, to eliminate this error in parallax work. By the method which is about to be presented, it is not necessary to apply any correction, which is constant for any plate, in the preliminary reductions of correcting the angles so they may be used in the parallax equations. Thus, in parallax work, it is unnecessary to apply corrections for orientation, precession, nutation and aberration separately. All these corrections may be grouped together as one correction.

Since there is the same inaccuracy in measuring the trail as there is in measuring the star, the weight of any star will be

$$\frac{\sigma^2 z^2}{\sigma^2 + z^2}$$

where z is the distance of the trail and where σ is the distance of the star.

In general, for a series of plates, we will have different values for the distance of the trail, as $z_1, z_2, \dots, z_n$. For the present purpose it will be sufficiently accurate to take z equal to the mean of all the values.

If we call O_1, O_2, O_3 , etc., the correction in angle for plates 1, 2, 3, etc., we will have equations of the form :

FOR PLATE I.

Star.

$$(1) \quad O_1 + \tau_1 y_1 + C_1' \Pi + d p_1 + n_1' = 0 \quad (a')$$

$$(2) \quad O_1 + \tau_1 y_2 + C_2' \Pi + d p_2 + n_2' = 0 \quad (b')$$

$$(3) \quad O_1 + \tau_1 y_3 + C_3' \Pi + d p_3 + n_3' = 0 \quad (c')$$

$$\dots\dots\dots$$

$$(r) \quad \begin{array}{l} O_1 + \tau_1 y_r + C_r' \Pi + d p_r + n_r' = 0 \\ O_1 + \tau_1 y_0 + C_0' \Pi + d p_0 + n_0' = 0 \end{array}$$

Weighted mean. A .

FOR PLATE 2.

Star.

$$(1) \quad O_2 + \tau_2 y_1 + C_1'' \Pi + d p_1 + n_1'' = 0 \quad (a'')$$

$$(2) \quad O_2 + \tau_2 y_2 + C_2'' \Pi + d p_2 + n_2'' = 0 \quad (b'')$$

$$(3) \quad O_2 + \tau_2 y_3 + C_3'' \Pi + d p_3 + n_3'' = 0 \quad (c'')$$

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.....

.....

$$(\gamma) \quad O_2 + \tau_2 y_r + C_r'' \Pi + d p_r + n_r'' = 0$$

$$O_2 + \tau_2 y_0 + C_0'' \Pi + d p_0 + n_0'' = 0 \quad \text{Weighted mean, } B.$$

We will have a similar expression for every plate. The absolute terms (n 's) are the difference between the observed position angle and the assumed position angle (obs.—assumed). They are expressed in seconds of angle.

In finding the equations called “weighted mean” only such stars should be used as are found upon all the plates.

The y 's are constant for any one star, no matter upon which plate it is found.

As the above equations show, the p 's are also constant for any star. They represent the quantities by which the assumed angle must be changed as a result of the orientation, proper motion and parallax.

After having found equations A , B , etc., by taking the weighted mean, we are prepared to form the parallax equations.

Suppose we wish to find the parallax by means of star t , which may or may not be one of the stars used in finding the weighted mean equation. From plate 1 we have the equation

$$O_1 + \tau_1 y_t + C_t' \Pi + d p_t + n_t' = 0.$$

From this we will subtract equation A , giving

$$\tau_1(y_t - y_0) + (C_t' - C_0') \Pi + (d p_t - d p_0) + (n_t' - n_0') = 0.$$

For plate 2 we would similarly have the equation

$$O_2 + \tau_2 y_t + C_t'' \Pi + d p_t + n_t'' = 0.$$

and uniting this with equation B , we have

$$\tau_2(y_t - y_0) + (C_t'' - C_0'') \Pi + (d p_t - d p_0) + (n_t'' - n_0'') = 0.$$

Each plate upon which star t is found would give an equation of this form, from which all the errors which are constant for any one plate have been eliminated.

If we let

$$\begin{aligned}y_t - y_0 &= y \\ d\phi_t - d\phi_0 &= x\end{aligned}$$

we will have, by rearranging the terms

$$\begin{aligned}x + \tau_1 y + (C_t' - C_0')\Pi + (n_t' - n_0') &= 0 \\ x + \tau_2 y + (C_t'' - C_0'')\Pi + (n_t'' - n_0'') &= 0 \\ \dots\dots\dots & \\ \dots\dots\dots &\end{aligned}$$

It may be stated here that the τ 's represent the time while the C 's are calculated in the ordinary manner.

This method requires but very little work which is not required by the other while there is a great saving in not being obliged to find the precession, nutation, aberration, special correction for western image, etc. All things considered it seems to be the better method when only parallax is sought.

A great advantage of this method is the fact that no special relations need be satisfied for the stars selected as standards. The regular method generally used requires the following conditions so the orientation may be free from proper motion and parallax effects :

$$\frac{\sum \sigma^2 S_r}{\sum \sigma^2} = 0$$

$$\frac{\sum \sigma^2 S_g}{\sum \sigma^2} = 0$$

$$\sum S_i = 0$$

By the method just proposed these conditions need not be satisfied. Such stars as are found on all the plates may be used without regard to other conditions.

Proper Motion.—The equations of condition for parallax contain a term depending upon the proper motion. In solving for parallax, then, a value for proper motion is obtained. This motion is the component in a direction perpendicular to the radius vector of the particular star from which it was obtained. Eleven different values were obtained for the different stars. It is a simple matter to reduce these values to right ascension and declination. The value thus obtained is only a relative proper

motion. But when a number of comparison stars are used it is very improbable that they all move in the same direction.

But before we find the proper motion, let it be stated emphatically that the plates are not well adapted to give us the proper motion. The time that elapsed between the taking of the first plate and the last, about $3\frac{1}{2}$ years, is too short to give a good determination. We would not expect the proper motion, therefore, to be as good as that found by a comparison of the different catalogues. In this latter case we have the observations of about 150 years at our disposal. And yet, in spite of these objections, it is of interest to see what information the plates will give as to the proper motion of μ . A solution has therefore been made.

If $w =$ correction to $\rho \cos \psi$
 $v =$ " " $\rho \sin \psi$,

we have the equation

$$w \cos \phi + v \sin \phi - y' = 0,$$

For the stars that were used for parallax, we therefore have the following weighted system of condition equations :

				Residual.
+ 0.317 ^v	— 9.90 ^v	+ .41	= 0	+ .56
— 6.40	— 5.60	+ .65		+ .33
+ 6.81	— 3.15	+ .52		+ .98
— 10.42	— 6.35	+ .13		— .43
— 9.16	— 8.06	+ .64		+ .19
+ 5.32	— 2.78	— 1.17		— .81
— 12.47	— 4.33	+ .93		+ .23
+ 12.32	+ 7.46	— .33		+ .32
— 7.37	+ 1.41	+ .96		+ .49
— 6.49	+ 9.74	+ .66		+ .13
+ 0.38	+ 6.19	+ .64		+ .54

$$\begin{aligned} 712.0813^w + 211.1132^v - 40.7112 &= 0 \\ + 461.8793^v - 6.8134 &= 0 \\ v &= -0.013 \pm \\ w &= +.061 \pm \end{aligned}$$

or, the corrected values are

$$\begin{aligned}\rho \cos \psi &= -1.519 \\ \rho \sin \psi &= +3.366 \\ \therefore \Delta \alpha &= +0^{\circ}.3845 \\ \Delta \delta &= -1.519\end{aligned}$$

Bradley gives

$$\begin{aligned}\Delta\alpha &= 0.3860 \\ \Delta\delta &= -1.580\end{aligned}$$

Porter gives

$$\begin{aligned}\Delta\alpha &= +0.389 \\ \Delta\delta &= -1.57\end{aligned}$$

The proper motion was also found by the use of catalogues in reducing the position of μ for 1872.0. This reduction by catalogues gave

$$\begin{aligned}\Delta\alpha &= +0.390 \\ \Delta\delta &= -1.57\end{aligned}$$

IV. SCALE VALUE AND ORIENTATION CORRECTION.

Method.—The scale value found by Professor Jacoby in the Pleiades paper was obtained by comparing the photographic measures “with the Königsberg and Yale heliometer measures.” In this way twenty independent determinations were obtained, giving the mean value for one division of the scale equal to $28''.0124$. This value was adopted in every subsequent paper published by the Columbia Observatory when the coördinates used were distance and position angle.

In reducing a catalogue of stars by means of photographic plates, it is of importance to have an accurate scale value. It has seemed advisable, therefore, to investigate the scale anew by a method entirely independent of the one used by Professor Jacoby. Accordingly a certain number of standard stars were selected and their positions were compared with the catalogue positions.

Stars Used.—For this purpose the stars numbered

$$\begin{array}{ccccccc} 8, & 9, & 10, & 13, & 14, \\ 15, & 16, & 18, & 19, & 20, \\ 21, & 25, & 26, & 28 \end{array}$$

were selected. In looking up the star places in quite a number of the fundamental catalogues, it was found that but two or three of the stars about μ Cass. had been catalogued prior to the

publication of the Astronomische Gesellschaft Catalogue. It was therefore necessary to accept the values of the A. G. C. as final. The position of μ , however, was found from the following catalogues :

Bradley	— 1755
DLX	— 1830
12 year	— 1840
Pulkowa	— 1855
9 year	— 1872
A. G. C.	— 1875
Romberg	— 1875
10 year	— 1880
Cinn.	— 1890.

The catalogue positions were reduced to 1872.0, the date to which the measures of the photographic plates were referred. We then immediately have $a' - a$, and $\delta' - \delta$ where (a', δ') are the coördinates of any standard star, and (a, δ) the coördinates of μ . The values of the differences of right ascension and declination have been tabulated.

TABLE XVI.

Star.	A. G. C. No.	$a' - a$	$\delta' - \delta$
8	485	—2926''.20	+ 45''.1
9	491	—2734.65	—2782.4
10	489	—2762.10	—1873.3
13	498	—2237.85	—1389.4
14	496	—2332.65	+ 2878.4
15	503	—1583.55	—3049.6
16	504	—1361.70	—1314.6
18	507	—1098.00	—731.7
19	508	— 892.05	991.3
20	509	— 758.25	—1284.7
21	510	— 655.80	—2189.4
25	517	— 677.40	651.5
26	519	+ 865.20	—2679.3
28	527	+ 2167.50	— 853.0

Formulæ for Finding Position Angle and Distance.—It now becomes necessary to calculate the position angles and dis-

tances for these standard stars. Series in ascending powers of $a' - a$ and $\delta' - \delta$ are required for this purpose. They may be obtained from Jordan's formula (20, p. 319).

If

σ = distance in seconds of arc,

π = position angle,

$\frac{1}{\rho} = \sin I''$,

$m = \sigma \sin I$,

$n = \sigma \cos I$,

α, δ = coördinates of central star,

then

$$\delta' - \delta = m - \frac{1}{2\rho} \tan \delta \cdot n^2 - \frac{1}{6\rho^2} (1 + 3 \tan^2 \delta) n^2 m$$

$$\cos \delta (a' - a) = n + \frac{1}{\rho} \tan \delta \cdot n \cdot m - \frac{1}{3\rho^2} \tan^2 \delta n^3 + \frac{1}{3\rho^2} (1 + 3 \tan^2 \delta) n m^2.$$

These formulæ may be inverted by the method of undetermined coefficients.

A preliminary examination shows that m and n may be expanded into a series of the general form

$$\begin{aligned} m &= \Delta\delta + A(\Delta_1 a)^2 + B(\Delta_1 a)^2 \Delta\delta \\ n &= \Delta_1 a + C \cdot \Delta_1 a \cdot \Delta\delta + D \Delta_1 a \cdot (\Delta\delta)^2 + E \cdot (\Delta_1 a)^3 \end{aligned}$$

where, for convenience, $\Delta\delta$ and $\Delta_1 a$ have been written in the place of $\delta' - \delta$ and $\cos \delta (a' - a)$, respectively.

We may then show that

$$\begin{aligned} A &= -\frac{1}{2\rho} \tan \delta \\ B &= \frac{1}{6\rho^2} (1 - 3 \tan^2 \delta) \\ C &= -\frac{1}{\rho} \tan \delta \\ D &= -\frac{1}{3\rho^2} \\ E &= -\frac{1}{6\rho^2} \tan^2 \delta \end{aligned}$$

We therefore have the convenient formulæ

$$\begin{aligned} m &= \Delta\delta - \frac{1}{2\rho} \sin \delta \cos \delta (\Delta a)^2 + \frac{1}{6\rho^2} (1 - 3 \tan^2 \delta) \cos^2 \delta (\Delta a)^2 \Delta\delta \\ n \cos \delta \cdot \Delta a &= \frac{1}{\rho} \sin \delta \cdot \Delta a \cdot \Delta\delta - \frac{1}{3\rho^2} \cos \delta \cdot \Delta a \cdot (\Delta\delta)^2 - \frac{1}{6\rho^2} \sin^2 \delta \cos \delta (\Delta a)^3, \end{aligned}$$

(214)

or, with numerical coefficients, where numbers in brackets designate logarithms, we have

$$\begin{aligned}\sigma \cos \pi &= \Delta \delta - [4.38454 - 10] \sin \delta \cdot \cos \delta \cdot (\Delta \alpha)^2 \\ &\quad + [8.59300 - 20] (1 - 3 \tan^2 \delta) \cos^2 \delta \cdot (\Delta \alpha)^2 \Delta \delta \\ \sigma \sin \pi &= \cos \delta \cdot \Delta \alpha - [4.68557 - 10] \sin \delta \cdot \Delta \alpha \cdot \Delta \delta \\ &\quad - [8.59300 - 20] \sin^2 \delta \cdot \cos \delta \cdot (\Delta \alpha)^3 \\ &\quad - [8.89403 - 20] \cos \delta \cdot \Delta \alpha \cdot (\Delta \delta)^2.\end{aligned}$$

For μ Cassiopeiæ these forms become

$$\begin{aligned}\sigma \cos \pi &= \Delta \delta + [4.06025 - 10] (\Delta \alpha)^2 - [8.8071 - 20] (\Delta \alpha)^2 \cdot \Delta \delta \\ \sigma \sin \pi &= [9.766163 - 10] \Delta \alpha - [4.59513 - 10] \Delta \alpha \cdot \Delta \delta \\ &\quad - [8.6602 - 20] \Delta \alpha \cdot (\Delta \delta)^2 - [8.1782 - 20] (\Delta \alpha)^3\end{aligned}$$

By means of these formulæ we may calculate the position angles and the distances when we know $\alpha' - \alpha$ and $\delta' - \delta$. Thus we find that the catalogue positions of the stars selected as standards give position angles and distances as tabulated :

TABLE XVII.

Star No.	Position Angle.			Distance.
	°	'	"	
8	271	50	30.0	1708.28
9	210	22	47.2	3215.16
10	221	12	23.7	2478.12
13	223	36	55.7	1911.10
14	335	9	46.1	3178.50
15	197	12	11.7	3189.38
16	211	25	14.0	1538.03
18	221	24	40.0	973.76
19	332	25	49.9	1117.26
20	199	10	14.5	1359.39
21	190	3	47.7	2222.80
25	31	7	30.0	761.65
26	169	8	6.1	2727.40
28	123	40	9.3	1528.94

Formulæ to find $\mathcal{A}R$ and $\mathcal{A}\pi$.—In Tables XX and XXI we have the values of the position angle and distances given for every plate. We are ready, therefore, to compare each plate separately with the tabulated catalogue elements. To do this we must have two formulæ, one for each coördinate.

If ΔR = correction to assumed scale value,

$\Delta\pi$ = correction to position angle.

$y \sec \delta$ = correction to right ascension of the central star to make it agree with the corrected position angle and distance, and

z = correction to declination of the central star,

P = photograph position,

C = catalogue position,

r = no. of divisions of the scale.

so that $\sigma + r\Delta R$ and $\pi + \Delta\pi$ are the corrected coördinates, then we have, for position angles,

$$\sigma \sin 1'' \cdot \Delta\pi + \cos \pi \cdot y - \sin \pi \cdot z + \sigma \sin 1''(P - C) = 0$$

and for the distances,

$$r \cdot \Delta R + \sin \pi \cdot y + \cos \pi \cdot z + (P - C) = 0. \quad (21 \text{ Gould, p. 48.})$$

The equations of condition are tabulated below and the normal equations are given, together with the result.

The coefficients of the first three terms, in both sets of equations, are the same for all the plates. The absolute terms, however, are different for each plate, and have been tabulated in the column bearing the number of the plate. Wherever a vacant space occurs, it signifies that the star was not found upon the plate in question. Thus, for example, stars 15 and 19 are not upon plate 38.

Method of Solving.—The two sets of equations of condition that we have for every plate are just a little peculiar. They contain but four unknown quantities. To get the best results we should add the corresponding equations for each plate. This would give a new series of equations of condition of the form

$$\sigma \sin 1'' \cdot \Delta\pi + r \cdot \Delta R + (\cos \pi + \sin \pi) \pi + (\cos \pi - \sin \pi) z + K = 0$$

where K is the absolute term. But Jordan (20, Vol. I, p. 78) has shown that this equation, involving four unknowns, may be avoided by finding the first reduced normals for each set separately, and then adding these reduced normals. This gives

identically the same result as would be obtained from the longer solution of the four unknowns in one system.

It may be of interest to give the solutions of one set of equations. For plate 54 we have the normals

$$\begin{aligned} .000810\Delta\pi - .0199y + .0101z + .0084 &= 0 \\ + 4.089y - 0.349z + 2.436 &= 0 \\ + 1.898z - 0.882 &= 0 \\ 43891.1\Delta R - 74.1y - 146.7z - 701.2 &= 0 \\ + 1.898y + 0.349z + 2.460 &= 0 \\ + 4.089z - 1.188 &= 0 \end{aligned}$$

The first reduced normals are, from first set,

$$\left. \begin{aligned} + 3.600y - 0.101z + 2.642 &= 0 \\ + 1.772z - 0.987 &= 0 \end{aligned} \right\} (a)$$

second set

$$\left. \begin{aligned} + 1.773y + .101z + 1.275 &= 0 \\ + 3.599z - 3.530 &= 0 \end{aligned} \right\} (b).$$

Adding a and b , we have

$$\left. \begin{aligned} + 5.373y + .000z + 3.917 &= 0 \\ + 5.371z - 4.517 &= 0 \end{aligned} \right\} (c)$$

giving

$$\left. \begin{aligned} z &= + .841 \\ y &= - .729 \end{aligned} \right\} (d)$$

as the best values for y and z .

Our first set of reduced equations being solved gives

$$\begin{aligned} z &= + .516 \\ y &= - .720 \end{aligned}$$

and the second set gives

$$\begin{aligned} z &= + 1.003 \\ y &= - .776. \end{aligned}$$

If we would take the mean of these values we would have

$$\begin{aligned} z &= + .710 \\ y &= - .748. \end{aligned}$$

These values differ considerably from those designated (a) .

In the solution given above it will be noticed that the coefficient of z , in equation c , reduces to zero. An examination of the form of the equations of condition shows that this coefficient must necessarily reduce to zero. This makes the solution for y and z a comparatively simple matter.

TABLE XVIII.—EQUATIONS OF CONDITION FOR ORIENTATION CORRECTION.

Plate Star.	31	32	33	34	36	37	38	40	41	42	43	44	45	46
8	$.0083\Delta\pi + .03v + 1.00z$	— .99	— .87	— .16	— .05	— .48	— .17	— .42	— .11	— .00	— .14	— .22	— .81	— .16
9	.0156	— .86	— .50	— .170	— .89	— .148	— .139	— .148	— .200	— .187	— .162	— .23	— .193	— .44
10	.0120	— .75	— .66	— .107	— .163		— .140	— .68	— .100	95		— .19	— .25	0
13	.0093	— .72	— .69	— .18			— .55		— .10	— .50	— .19	— .47	— .31	0
14	.0154	— .91	— .42	— .86	— .108		— .89	— .119	— .09	— .15	— .69	— .37	— .51	— .68
15	.0154	— .96	— .30	— .23	— .03	— .51	— .11	— .12	— .40	— .11	— .37	— .37	— .70	0
16	.0074	— .85	— .52	— .60	— .81	— .102	— .76	— .101	— .110	— .123	— .93	— .86	— .61	— .93
18	.0047	— .75	— .66	— .116	— .131	— .144	— .183	— .132	— .115	— .105	— .129	— .108	— .117	— .21
19	.0054	— .89	— .46	— .33	— .36	— .06	— .30	— .29	— .44	— .29	— .38	— .42	— .50	0
20	.0066	— .94	— .33	— .71	— .127	— .04	— .91	— .90	— .139	— .78	— .93	— .116	— .86	0
21	.0108	— .98	— .17	— .32	— .50	— .62	— .08	— .109	— .05	— .55	— .46	— .31	— .39	— .84
25	.0037	— .86	— .52	— .105	— .135	— .129	— .07	— .159	— .114	— .135	— .101	— .125	— .100	— .138
26	.0132	— .98	— .19	— .17	— .235	— .32	— .22	— .01	— .40	— .115	— .22	— .17	— .33	— .00
28	.0074	— .55	— .83	— .19	— .19	— .28	— .36	— .35	— .10	— .37	— .60	— .25	— .72	— .25
Star.		47	48	49	50	51	52	53	54	55	56	57	58	59
8	$.0083\Delta\pi + .03v + 1.00z$	— .134	— .101	— .105	— .101	— .105	— .105	— .89	— .126	— .134	— .120	— .125	— .135	— .124
9	.0156	— .86	— .50	— .156	— .167	— .164	— .164	— .198	— .126	— .134	— .120	— .125	— .135	— .124
10	.0120	— .75	— .66	— .106	— .96	— .109	— .92	— .92	— .90	— .126	— .120	— .125	— .135	— .124
13	.0093	— .72	— .69	— .48	— .18	— .78	— .78	— .90	— .90	— .126	— .120	— .125	— .135	— .124
14	.0154	— .91	— .42	— .51	— .22	— .37	— .74	— .71	— .105	— .74	— .117	— .89	— .68	— .111
15	.0154	— .96	— .30	— .25	— .46	— .03	— .03	— .16	— .116	— .76	— .76	— .52	— .37	— .29
16	.0074	— .85	— .52	— .115	— .92	— .90	— .90	— .16	— .116	— .76	— .76	— .52	— .37	— .29
18	.0047	— .75	— .66	— .141	— .94	— .109	— .110	— .96	— .122	— .76	— .76	— .52	— .37	— .29
19	.0054	— .89	— .46	— .11	— .08	— .18	— .25	— .33	— .33	— .105	— .105	— .129	— .108	— .117
20	.0066	— .94	— .33	— .86	— .116	— .105	— .69	— .94	— .97	— .105	— .105	— .129	— .108	— .117
21	.0108	— .98	— .17	— .13	— .29	— .24	— .31	— .57	— .57	— .105	— .105	— .129	— .108	— .117
25	.0037	— .86	— .52	— .105	— .106	— .113	— .113	— .119	— .119	— .105	— .105	— .129	— .108	— .117
26	.0132	— .98	— .19	— .16	— .37	— .16	— .16	— .50	— .18	— .38	— .01	— .09	— .10	— .28
28	.0074	— .55	— .83	— .11	— .21	— .19	— .35	— .40	— .36	— .04	— .58	— .73	— .66	— .67
Star.		47	48	49	50	51	52	53	54	55	56	57	58	59
8	$.0083\Delta\pi + .03v + 1.00z$	— .134	— .101	— .105	— .101	— .105	— .105	— .89	— .126	— .134	— .120	— .125	— .135	— .124
9	.0156	— .86	— .50	— .156	— .167	— .164	— .164	— .198	— .126	— .134	— .120	— .125	— .135	— .124
10	.0120	— .75	— .66	— .106	— .96	— .109	— .92	— .92	— .90	— .126	— .120	— .125	— .135	— .124
13	.0093	— .72	— .69	— .48	— .18	— .78	— .78	— .90	— .90	— .126	— .120	— .125	— .135	— .124
14	.0154	— .91	— .42	— .51	— .22	— .37	— .74	— .71	— .105	— .74	— .117	— .89	— .68	— .111
15	.0154	— .96	— .30	— .25	— .46	— .03	— .03	— .16	— .116	— .76	— .76	— .52	— .37	— .29
16	.0074	— .85	— .52	— .115	— .92	— .90	— .90	— .16	— .116	— .76	— .76	— .52	— .37	— .29
18	.0047	— .75	— .66	— .141	— .94	— .109	— .110	— .96	— .122	— .76	— .76	— .52	— .37	— .29
19	.0054	— .89	— .46	— .11	— .08	— .18	— .25	— .33	— .33	— .105	— .105	— .129	— .108	— .117
20	.0066	— .94	— .33	— .86	— .116	— .105	— .69	— .94	— .97	— .105	— .105	— .129	— .108	— .117
21	.0108	— .98	— .17	— .13	— .29	— .24	— .31	— .57	— .57	— .105	— .105	— .129	— .108	— .117
25	.0037	— .86	— .52	— .105	— .106	— .113	— .113	— .119	— .119	— .105	— .105	— .129	— .108	— .117
26	.0132	— .98	— .19	— .16	— .37	— .16	— .16	— .50	— .18	— .38	— .01	— .09	— .10	— .28
28	.0074	— .55	— .83	— .11	— .21	— .19	— .35	— .40	— .36	— .04	— .58	— .73	— .66	— .67
Star.		47	48	49	50	51	52	53	54	55	56	57	58	59
8	$.0083\Delta\pi + .03v + 1.00z$	— .134	— .101	— .105	— .101	— .105	— .105	— .89	— .126	— .134	— .120	— .125	— .135	— .124
9	.0156	— .86	— .50	— .156	— .167	— .164	— .164	— .198	— .126	— .134	— .120	— .125	— .135	— .124
10	.0120	— .75	— .66	— .106	— .96	— .109	— .92	— .92	— .90	— .126	— .120	— .125	— .135	— .124
13	.0093	— .72	— .69	— .48	— .18	— .78	— .78	— .90	— .90	— .126	— .120	— .125	— .135	— .124
14	.0154	— .91	— .42	— .51	— .22	— .37	— .74	— .71	— .105	— .74	— .117	— .89	— .68	— .111
15	.0154	— .96	— .30	— .25	— .46	— .03	— .03	— .16	— .116	— .76	— .76	— .52	— .37	— .29
16	.0074	— .85	— .52	— .115	— .92	— .90	— .90	— .16	— .116	— .76	— .76	— .52	— .37	— .29
18	.0047	— .75	— .66	— .141	— .94	— .109	— .110	— .96	— .122	— .76	— .76	— .52	— .37	— .29
19	.0054	— .89	— .46	— .11	— .08	— .18	— .25	— .33	— .33	— .105	— .105	— .129	— .108	— .117
20	.0066	— .94	— .33	— .86	— .116	— .105	— .69	— .94	— .97	— .105	— .105	— .129	— .108	— .117
21	.0108	— .98	— .17	— .13	— .29	— .24	— .31	— .57	— .57	— .105	— .105	— .129	— .108	— .117
25	.0037	— .86	— .52	— .105	— .106	— .113	— .113	— .119	— .119	— .105	— .105	— .129	— .108	— .117
26	.0132	— .98	— .19	— .16	— .37	— .16	— .16	— .50	— .18	— .38	— .01	— .09	— .10	— .28
28	.0074	— .55	— .83	— .11	— .21	— .19	— .35	— .40	— .36	— .04	— .58	— .73	— .66	— .67

TABLE XVIII.--EQUATIONS OF CONDITION TO DETERMINE CORRECTION TO SCALE VALUE.

Plate Star.	31	32	33	34	36	37	38	40	41	42	43	44	45	46
8	+ 60.97 ΔR	-1.00 y + .03 z	-1.17 -1.30 - .88	-1.19	-2.05	-1.80	-1.28	-1.67	-1.54	-1.16	-1.01	- .51	-1.01	-1.03
9	+ 114.74	- .50 - .86	-2.93 -2.32 -2.46	-2.34	-2.05	-1.80	-2.24	-2.45	-2.48	-2.38	-2.02	-1.61	-2.12	-2.14
10	+ 88.52	- .66 - .75	+ .31 + .72 + .63	+ .62	- .06	- .00	- .06	- .06	- .19	+ .24	- .73	- .70	+ .70	- .84
13	+ 68.22	- .69 - .72	- .80 - .78	- .79	- .348	- .69	- .69	- .69	- .04	- .79	- .73	- .70	- .70	- .84
14	+ 113.40	- .42 + .91	-3.19 -3.05 -2.93	-3.17	-3.59	-3.48	-3.48	-3.73	-2.90	-3.54	-3.09	-3.15	-3.45	-3.21
15	+ 113.85	- .30 - .96	-1.65 -1.27 -1.46	-1.31	-1.39	-1.61	-1.61	-2.15	-2.46	-2.21	-1.16	-1.61	-1.61	-1.61
16	+ 54.92	- .52 - .85	+ .31 + .12 + .01	+ .09	+ .16	+ .21	+ .16	+ .17	+ .03	+ .07	+ .11	+ .05	+ .06	+ .09
18	+ 34.78	- .66 - .75	+ .08 + .01 + .25	- .05	- .05	+ .24	+ .13	- .57	- .39	- .29	+ .00	+ .15	+ .09	+ .04
19	+ 39.93	- .46 + .89	- .69 - .67 - .37	- .80	- .05	- .61	- .61	-1.23	- .48	- .71	- .49	- .22	- .96	- .51
20	+ 48.55	- .33 - .94	- .08 + .09 + .12	- .09	+ .05	+ .20	+ .32	- .49	- .39	+ .10	- .03	+ .03	+ .03	+ .25
21	+ 79.34	- .17 - .98	-1.27 - .99 -1.04	-1.12	- .99	- .99	- .88	-1.53	-1.81	-1.25	- .96	- .80	-1.07	-1.36
25	+ 27.17	+ .52 + .86	- .59 - .42 - .71	- .62	- .51	- .54	- .64	- .50	- .47	- .94	- .80	- .84	- .82	- .67
26	+ 97.38	+ .19 - .98	- .75 - .73 - .97	-1.03	- .85	-1.02	- .79	-1.37	-1.18	- .99	- .95	- .95	-1.15	- .87
28	+ 54.60	+ .83 - .55	+ .06 - .16 - .23	+ .03	- .26	+ .24	+ .25	- .24	- .44	- .24	+ .07	- .14	- .06	+ .01
Star.	47	48	49	50	51	52	53	54	55	56	57	58	59	60
8	+ 60.97 ΔR	-1.00 y + .03 z	-1.60 -1.75 -1.30	-1.39	-1.29	-1.13	-1.13	-1.13	-1.85	-2.21	-2.58	-1.14	-1.09	-1.36
9	+ 114.74	- .50 - .86	-2.36 -2.83 -2.54	-2.52	-2.42	-1.99	-2.76	-2.76	-1.85	-2.21	-2.58	-2.37	-2.22	-2.25
10	+ 88.52	- .66 - .75	- .10 - .38	+ .03	- .29	- .06	- .06	- .06	- .42	- .01	- .02	- .10	- .02	- .14
13	+ 68.22	- .69 - .72	-1.45	- .66	- .67	-1.25	-1.25	-1.25	- .42	- .85	- .85	- .92	- .85	- .78
14	+ 113.40	- .42 + .91	-3.56 -2.54 -2.56	-2.62	-3.25	-2.99	-3.25	-3.25	-3.39	-3.36	-3.16	-3.54	-3.59	-3.43
15	+ 113.85	- .30 - .96	-2.24 -2.25 -2.37	-2.27	-1.43	- .00	- .45	- .45	- .45	- .21	- .01	-2.14	-1.87	-1.80
16	+ 54.92	- .52 - .85	- .42 - .72 - .10	- .21	- .06	- .00	- .45	- .45	- .45	+ .01	+ .01	- .08	+ .16	+ .13
18	+ 34.78	- .66 - .75	- .06 - .41 - .31	- .41	- .05	- .29	- .40	- .40	- .40	- .07	- .07	- .01	+ .07	+ .19
19	+ 39.93	- .46 + .89	- .44 - .49 - .54	- .60	- .83	- .48	- .48	- .48	- .48	- .70	- .70	- .71	- .70	- .84
20	+ 48.55	- .33 - .94	- .32 - .50 + .05	- .08	+ .17	+ .11	- .24	- .24	- .24	+ .06	+ .28	+ .06	+ .28	+ .45
21	+ 79.34	- .17 - .98	-1.53 -1.68 -1.54	-1.47	-1.15	- .94	- .92	- .92	- .92	-1.19	-1.53	-1.53	-1.26	-1.14
25	+ 27.17	+ .52 + .86	- .81 -1.05 - .74	- .90	- .68	- .57	- .34	- .34	- .67	- .62	- .98	-1.09	-1.24	-1.15
26	+ 97.38	+ .19 - .98	-1.91 -1.27 -1.28	-1.24	-1.00	- .04	-1.04	-1.04	- .81	-1.08	-1.05	-1.21	-1.10	- .86
28	+ 54.60	+ .83 - .55	- .60 - .35 - .38	- .43	- .07	- .04	- .10	- .10	+ .39	+ .14	- .23	- .34	- .64	- .31

FOR PLATE 31.

$$\begin{aligned}
.001526\Delta\pi - .0652y + .0444z - .0686 &= 0 \\
+ 9.495y - 2.106z + 6.820 &= 0 \\
+ 4.479z - 5.510 &= 0 \\
+ 82868.2\Delta R - 327.0y - 481.2z - 1216.4 &= 0 \\
+ 4.479y + 2.106z + 5.086 &= 0 \\
+ 9.495z + 2.613 &= 0 \\
\Delta R = +.0180, \quad \Delta\pi = -9.436, \quad y = -.421, \quad z = +.806.
\end{aligned}$$

FOR PLATE 32.

$$\begin{aligned}
.001526\Delta\pi - .0652y + .0444z - .0576 &= 0 \\
+ 9.495y - 2.106z + 6.617 &= 0 \\
+ 4.479z - 5.907 &= 0 \\
82868.2\Delta R - 327.0y - 481.2z - 1010.7 &= 0 \\
+ 4.479y + 2.106z + 4.073 &= 0 \\
+ 9.495z + 1.044 &= 0 \\
\Delta R = +.0161, \quad \Delta\pi = -24.55, \quad y = -.428, \quad z = +.916.
\end{aligned}$$

FOR PLATE 33.

$$\begin{aligned}
.001440\Delta\pi - .0585y + .0380z - .0460 &= 0 \\
+ 8.976y - 1.610z + 4.794 &= 0 \\
+ 4.003z - 4.651 &= 0 \\
78214.2\Delta R - 280.0y - 432.1z - 987.2 &= 0 \\
+ 4.003y + 1.610z + 2.756 &= 0 \\
+ 8.976z + 1.200 &= 0 \\
\Delta R = +.0170, \quad \Delta\pi = -15.589, \quad y = -.223, \quad z = +.801.
\end{aligned}$$

FOR PLATE 34.

$$\begin{aligned}
.001526\Delta\pi - .0652y + .0444z - .0949 &= 0 \\
+ 9.495y - 2.106z + 9.834 &= 0 \\
+ 4.479z - 4.630 &= 0 \\
82868.2\Delta R - 327.0y - 481.2z - 1086.2 &= 0 \\
+ 4.479y + 2.106z + 4.301 &= 0 \\
+ 9.495z + 1.344 &= 0 \\
\Delta R = +.0172, \quad \Delta\pi = +10.616, \quad y = -.585, \quad z = +.691.
\end{aligned}$$

FOR PLATE 36.

$$\begin{aligned}
.001175\Delta\pi - .0511y + .0162z - .0037 &= 0 \\
+ 7.058y - 1.059z + 4.272 &= 0 \\
+ 1.920z - 1.744 &= 0 \\
63864.8\Delta R - 119.3y - 377.0z - 950.3 &= 0 \\
+ 1.920y + 1.059z + 2.808 &= 0 \\
+ 7.058z + 0.869 &= 0 \\
\Delta R = +.0195, \quad \Delta\pi = -42.646, \quad y = -.799, \quad z = +.985.
\end{aligned}$$

FOR PLATE 37.

$$\begin{aligned}
 .000752\Delta\pi - .0490y + .0107z - .0438 &= 0 \\
 + 6.663y - 1.239z + 5.084 &= 0 \\
 + 2.301z - 3.400 &= 0 \\
 40849.5\Delta R - 78.8y - 361.4z - 400.2 &= 0 \\
 + 2.301y + 1.239z + .740 &= 0 \\
 + 6.663z + 1.832 &= 0 \\
 \Delta R = +.0141, \quad \Delta\pi = +11.888, \quad y = -.391, \quad z = +.798.
 \end{aligned}$$

FOR PLATE 38.

$$\begin{aligned}
 +.001260\Delta\pi - .0552y + .0373z - .0310 &= 0 \\
 + 7.781y - 2.228z + 5.798 &= 0 \\
 + 4.177z - 5.000 &= 0 \\
 68312.0\Delta R - 274.5y - 407.4z - 898.4 &= 0 \\
 + 4.177y + 2.228z + 3.937 &= 0 \\
 + 7.781z - .368 &= 0 \\
 \Delta R = +.0185, \quad \Delta\pi = -41.221, \quad y = -.564, \quad z = +1.163.
 \end{aligned}$$

FOR PLATE 40.

$$\begin{aligned}
 .001440\Delta\pi - .0585y + .0380z - .0446 &= 0 \\
 + 8.976y - 1.610z + 6.535 &= 0 \\
 + 4.003z - 4.542 &= 0 \\
 + 78214.2\Delta R - 279.9y - 432.1z - 1439.3 &= 0 \\
 + 4.003y + 1.610z + 5.879 &= 0 \\
 + 8.976z + 3.254 &= 0 \\
 \Delta R = +.0214, \quad \Delta\pi = -26.740, \quad y = -.567, \quad z = +.840.
 \end{aligned}$$

FOR PLATE 41.

$$\begin{aligned}
 .001526\Delta\pi - .0652y + .0444z - .0977 &= 0 \\
 + 9.495y - 2.106z + 8.247 &= 0 \\
 + 4.479z - 5.734 &= 0 \\
 82868.2\Delta R - 327.1y - 481.2z - 1423.8 &= 0 \\
 + 4.479y + 2.106z + 5.675 &= 0 \\
 + 9.495z + 5.726 &= 0 \\
 \Delta R = +.0192, \quad \Delta\pi = +14.056, \quad y = -.417, \quad z = +.550.
 \end{aligned}$$

FOR PLATE 42.

$$\begin{aligned}
 .001526\Delta\pi - .0652y + .0444z - .0527 &= 0 \\
 + 9.495y - 2.106z + 4.396 &= 0 \\
 + 4.479z - 4.727 &= 0 \\
 82868.2\Delta R - 327.1y - 481.2z - 1301.2 &= 0 \\
 + 4.479y + 2.106z + 4.744 &= 0 \\
 + 9.495z + 2.371 &= 0 \\
 \Delta R = +.0205, \quad \Delta\pi = -6.317, \quad y = -.176, \quad z = +.848.
 \end{aligned}$$

FOR PLATE 43.

$$\begin{aligned}
.001145\Delta\pi - .0414y + .0319z - .0349 &= 0 \\
8.011y - 1.324z + 4.965 &= 0 \\
+ 3.953z - 4.040 &= 0 \\
62070.6\Delta R - 234.5y - 305.5z - 895.2 &= 0 \\
+ 3.953y + 1.324z + 3.624 &= 0 \\
+ 8.011z + 0.308 &= 0 \\
\Delta R = +.0171, \quad \Delta\pi = -16.181, \quad y = -.411, \quad z = +.748.
\end{aligned}$$

FOR PLATE 44.

$$\begin{aligned}
.001101\Delta\pi - .0352y + .0297z - .0289 &= 0 \\
+ 7.127y - 1.013z + 2.628 &= 0 \\
+ 3.844z - 4.174 &= 0 \\
59713.4\Delta R - 218.5y - 259.8z - 808.1 &= 0 \\
+ 3.844y + 1.013z + 2.500 &= 0 \\
+ 7.127z - 0.274 &= 0 \\
\Delta R = +.0168, \quad \Delta\pi = -12.366, \quad y = -0.137, \quad z = +.794.
\end{aligned}$$

FOR PLATE 45.

$$\begin{aligned}
.001144\Delta\pi - .0585y + .0380z - .0560 &= 0 \\
+ 8.976y - 1.610z + 6.003 &= 0 \\
+ 4.003z - 5.111 &= 0 \\
+ 78214.2\Delta R - 280.0y - 432.1z - 1070.2 &= 0 \\
+ 4.003y + 1.610z + 3.368 &= 0 \\
+ 8.976z + 0.176 &= 0 \\
\Delta R = +.0190, \quad \Delta\pi = -15.075, \quad y = -.339, \quad z = +.976.
\end{aligned}$$

FOR PLATE 46.

$$\begin{aligned}
.001145\Delta\pi - .0414y - .0319z - .0287 &= 0 \\
+ 8.011y - 1.324z + 3.972 &= 0 \\
+ 3.953z - 3.946 &= 0 \\
62070.6\Delta\pi - 234.5y - 305.5z - 941.9 &= 0 \\
+ 3.953y + 1.324z + 3.832 &= 0 \\
+ 8.011z + 0.301 &= 0 \\
\Delta R = +.0179, \quad \Delta\pi = -18.164, \quad y = -.335, \quad z = +.781.
\end{aligned}$$

FOR PLATE 47.

$$\begin{aligned}
.001440\Delta\pi - .0585y + .0380z - .0580 &= 0 \\
+ 8.976y - 1.610z + 4.672 &= 0 \\
+ 4.003z - 5.329 &= 0 \\
+ 78214.2\Delta R - 280.0y - 432.1z - 1386.0 &= 0 \\
+ 4.003y + 1.610z + 4.694 &= 0 \\
+ 8.976z + 3.578 &= 0 \\
\Delta R = +.0214, \quad \Delta\pi = -6.609, \quad y = -.213, \quad z = +.821.
\end{aligned}$$

FOR PLATE 48.

$$\begin{aligned}
.001526\Delta\pi - .0652y + .0444z - .0529 &= 0 \\
+ 9.495y - 2.106z + 6.044 &= 0 \\
+ 4.479z - 3.963 &= 0 \\
82868.2\Delta R - 327.1y - 481.2z - 1510.4 &= 0 \\
+ 4.479y + 2.106z + 6.401 &= 0 \\
+ 9.495z + 6.693 &= 0 \\
\Delta R = +.0194, \quad \Delta\pi = -9.567, \quad y = -.426, \quad z = +.456.
\end{aligned}$$

FOR PLATE 49.

$$\begin{aligned}
.001296\Delta\pi - .0495y + .0301z - .0432 &= 0 \\
+ 8.4138y - 1.1147z + 5.4066 &= 0 \\
+ 3.567z - 3.828 &= 0 \\
70378.4\Delta R - 221.6y - 365.7z - 1253.8 &= 0 \\
+ 3.567y + 1.115z + 4.163 &= 0 \\
+ 8.414z + 4.217 &= 0 \\
\Delta R = +.0194, \quad \Delta\pi = -11.871, \quad y = -.422, \quad z = +.547.
\end{aligned}$$

FOR PLATE 50.

$$\begin{aligned}
.001526\Delta\pi - .0652y + .0444z - .0641 &= 0 \\
+ 9.495y - 2.106z + 5.940 &= 0 \\
+ 4.479z - 4.615 &= 0 \\
82868.2\Delta R - 327.1y - 481.2z - 1310.7 &= 0 \\
+ 4.479y + 2.106z + 4.739 &= 0 \\
+ 9.495z + 4.519 &= 0 \\
\Delta R = +.0189, \quad \Delta\pi = -1.483, \quad y = -.279, \quad z = +.591.
\end{aligned}$$

FOR PLATE 51.

$$\begin{aligned}
.001526\Delta\pi - .0652y + .0444z - .0444 &= 0 \\
+ 9.495y - 2.106z + 4.660 &= 0 \\
+ 4.479z - 4.230 &= 0 \\
82868.2\Delta R - 327.1y - 481.2z - 1199.9 &= 0 \\
+ 4.479y + 2.106z + 4.931 &= 0 \\
+ 9.495z + 1.908 &= 0 \\
\Delta R = +.0184, \quad \Delta\pi = -13.432, \quad y = -.298, \quad z = +.809.
\end{aligned}$$

FOR PLATE 52.

$$\begin{aligned}
.000959\Delta\pi - .0311y + .0276z - .0409 &= 0 \\
+ 7.093y - 1.538z + 5.862 &= 0 \\
+ 2.877z - 3.817 &= 0 \\
52052.2\Delta R - 203.4y - 229.2z - 688.9 &= 0 \\
+ 2.877y + 1.538z + 2.496 &= 0 \\
+ 7.093z - 0.825 &= 0 \\
\Delta R = +.0157, \quad \Delta\pi = -8.729, \quad y = -.409, \quad z = +.795.
\end{aligned}$$

FOR PLATE 53.

$$\begin{aligned}
.001116\Delta\pi - .0462y + .0294z - .0080 &= 0 \\
+ 7.218y - 1.733z + 3.595 &= 0 \\
+ 3.742z - 3.320 &= 0 \\
60476.2\Delta R - 216.1y - 341.0z - 1078.6 &= 0 \\
+ 3.742y + 1.733z + 5.014 &= 0 \\
+ 7.218z + 2.874 &= 0 \\
\Delta R = +.0197, \quad \Delta\pi = -39.641, \quad z = +.764, \quad y = -.535.
\end{aligned}$$

FOR PLATE 54.

$$\begin{aligned}
.000810\Delta\pi - .0199y + .0101z + .0084 &= 0 \\
+ 4.089y - 0.349z + 2.436 &= 0 \\
+ 1.898z - 0.882 &= 0 \\
43891.1\Delta R - 74.1y - 146.7z - 701.2 &= 0 \\
+ 1.898y + 0.349z + 2.460 &= 0 \\
+ 4.089z - 1.188 &= 0 \\
\Delta R = +.0180, \quad \Delta\pi = -34.573, \quad y = -.729, \quad z = +.841.
\end{aligned}$$

FOR PLATE 55.

$$\begin{aligned}
.000724\Delta\pi - .0132y + .0037z - .0072 &= 0 \\
+ 3.570y + 0.148z + 3.355 &= 0 \\
+ 1.422z - 0.943 &= 0 \\
39229.0\Delta R - 26.9y - 97.6z - 749.0 &= 0 \\
+ 1.422y - 0.148z + 2.105 &= 0 \\
+ 3.570z - 0.708 &= 0 \\
\Delta R = +.0203, \quad \Delta\pi = -12.697, \quad y = -1.037, \quad z = +.736.
\end{aligned}$$

FOR PLATE 56.

$$\begin{aligned}
.000895\Delta\pi - .0301y + .0094z + .0049 &= 0 \\
+ 5.253y - 0.461z + 2.786 &= 0 \\
+ 1.721z - 1.384 &= 0 \\
48537.2\Delta R - 69.1y - 222.0z - 889.7 &= 0 \\
+ 1.721y + 0.461z + 1.914 &= 0 \\
+ 5.253z + 0.814 &= 0 \\
\Delta R = +.0212, \quad \Delta\pi = -36.651, \quad y = -.614, \quad z = +.798.
\end{aligned}$$

FOR PLATE 57.

$$\begin{aligned}
.001526\Delta\pi - 0.0652y + .0444z - .0153 &= 0 \\
+ 9.295y - 2.106z + 2.992 &= 0 \\
+ 4.479z - 4.199 &= 0 \\
82868.2\Delta R - 327.1y - 481.2z - 1375.7 &= 0 \\
+ 4.479y + 2.106z + 4.691 &= 0 \\
+ 9.495z + 2.896 &= 0 \\
\Delta R = +.0217, \quad \Delta\pi = -37.069, \quad y = -.157, \quad z = +.895.
\end{aligned}$$

FOR PLATE 58.

$$\begin{aligned} .001526\Delta\pi - .0652y + .0444z - .0202 &= 0 \\ + 9.495y - 2.106z + 2.416 &= 0 \\ + 4.479z - 4.546 &= 0 \end{aligned}$$

$$\begin{aligned} 82868.2\Delta R - 327.1y - 481.2z - 1276.3 &= 0 \\ + 4.479y + 2.106z + 3.772 &= 0 \\ + 9.495z + 1.526 &= 0 \end{aligned}$$

$$\Delta R = +.0218, \quad \Delta\pi = -30.759, \quad y = -.283, \quad z = +.996$$

FOR PLATE 59.

$$\begin{aligned} .001409\Delta\pi - .0546y + .0426z - .0265 &= 0 \\ + 8.534y - 1.940z + 3.680 &= 0 \\ + 4.450z - 4.852 &= 0 \end{aligned}$$

$$\begin{aligned} 76573.3\Delta R - 313.5y - 403.4z - 1103.9 &= 0 \\ + 4.450y + 1.940z + 3.885 &= 0 \\ + 8.534z - 0.488 &= 0 \end{aligned}$$

$$\Delta R = +.0200, \quad \Delta\pi = -32.747, \quad y = -.211, \quad z = +1.082.$$

FOR PLATE 60.

$$\begin{aligned} + .001526\Delta\pi - .0652y + .0444z - .0010 &= 0 \\ + 9.495y - 2.106z + 1.880 &= 0 \\ + 4.479z - 5.262 &= 0 \end{aligned}$$

$$\begin{aligned} 82868.2\Delta R - 327.1y - 481.2z - 1202.1 &= 0 \\ + 4.479y + 2.106z + 3.845 &= 0 \\ + 9.495z + 0.947 &= 0 \end{aligned}$$

$$\Delta R = +.0206, \quad \Delta\pi = -56.205, \quad y = -.0919, \quad z = +1.140.$$

Results Tabulated.—For convenience of reference the results of the solution of our normals have been tabulated. The first column gives the number of the plate; the second, the scale value for that plate; the third, the orientation correction; the fourth, the relative change of μ in the direction of right ascension; the fifth, the correction the centre requires in declination; the sixth, the correction the centre requires in right ascension.

TABLE XIX.

Pl.	Scale.	$\Delta\pi$	y'	z	$y \sec \delta$
31	28.0180	— 9.436	— .421	+ .806	— .72
32	.0161	— 24.552	— .428	+ .916	— .73
33	.0170	— 15.589	— .223	+ .801	— .38
34	.0172	+ 10.616	— .585	+ .691	— 1.00
36	.0195	— 42.646	— .799	+ .985	— 1.37
37	.0141	+ 11.888	— .391	+ .798	— .67
38	.0185	— 41.221	— .564	+ 1.163	— .96
40	.0214	— 26.740	— .567	+ .840	— .97
41	.0192	+ 14.056	— .417	+ .550	— .71
42	.0205	— 6.317	— .176	— .848	— .30
43	.0171	— 16.181	— .411	+ .748	— .70
44	.0168	— 12.366	— .137	+ .794	— .23
45	.0190	— 15.075	— .339	+ .976	— .58
46	.0179	— 18.164	— .335	+ .781	— .57
47	.0214	— 6.609	— .213	— .821	— .36
48	.0194	— 9.567	— .426	+ .456	— .73
49	.0194	— 11.871	— .422	+ .547	— .72
50	.0189	— 1.483	— .279	+ .591	— .48
51	.0184	— 13.432	— .298	+ .809	— .51
52	.0157	— 8.729	— .409	+ .795	— .70
53	.0197	— 39.641	— .535	+ .764	— .91
54	.0180	— 34.573	— .729	+ .841	— 1.25
55	.0203	— 12.697	— 1.037	+ .736	— 1.77
56	.0212	— 36.651	— .614	— .798	— 1.05
57	.0217	— 37.069	— .157	— .895	— .27
58	.0218	— 30.759	— .283	+ .996	— .48
59	.0200	— 32.747	— .211	+ 1.082	— .36
60	.0206	— 56.205	— .092	1.140	— .16
	.0189				

Application of Corrections.—The scale value and orientation correction were applied to the distances and position angles. The corrections y' and z might also have been applied to these coördinates, thus making the residuals smaller. The distances would require a correction of the forms

$$\sin \pi \cdot y' + \cos \pi \cdot z$$

and the position angles a correction of the form

$$\cos \pi \cdot y' - \sin \pi \cdot z.$$

These corrections would make the interagreement of the plates as perfect as possible. But since $y \sec \delta$ and z are the

exact corrections to the differences of right ascension and declination, respectively, they were not applied until these differences were calculated. This made the application of these corrections a very simple matter.

Discussion of Scale Value.—It will be noticed that the largest scale value is $28''.0218$ and the smallest $28''.0141$, giving a difference of but $0''.0077$. When we consider that some of these values are dependent upon but five or six stars, we cannot but be surprised at the close agreement.

The mean of the 28 plates is $28''.0189$, a value somewhat larger than that found by Professor Jacoby. He found the mean of twenty independent determinations to be $28''.0124$. Again, when we remember that the one was found by a comparison with but one catalogue while the other was found by a comparison with the accurately determined heliometer positions, we are not surprised to find so great a difference as $0''.0065$, but rather to find so small a difference.

Discussion of Orientation Correction.—When we remember that an orientation correction has already been applied and that the correction now found is simply a correction to the former value, it may seem that the tabulated value is unduly large. But we must bear in mind that the two methods used do not give the same kind of a correction. The first method was simply a comparison of plates. It does not, in any way, take account of corrections constant for all the plates, but is rather a method of finding a mean value, as it were. It gives about an equal number of positive and negative corrections. The second method, on the contrary, gives the absolute corrections, each plate being determined independently of the others. If any constant errors exist in the measures of the plates they will be determined. The accuracy of this method is limited only by the accuracy of the catalogue positions of the standard stars. In view of these considerations the largest correction, $-56''.2$, does not seem unduly large. Most of the plates require a negative correction, as seen from a glance at our table. This would signify that certain constant errors of position angle did really exist, but our table also shows that these errors are very small.

V. CATALOGUE.

Formulæ.—The corrected distances and position angles are given in Tables XX and XXI, respectively.

By means of the formulæ already referred to under *Scale Value* (IV), we may convert these coördinates into right ascension and declination.

Letting.

α, δ be the coördinates of the central star.

α', δ' be the coördinates of any other star.

σ, π the distance and position angle, respectively, with reference to the central star.

$$m = \sigma \cos \pi$$

$$n = \sigma \sin \pi,$$

we have

$$\begin{aligned} \delta' - \delta &= m - [4.384545 - 10]n^2 \tan \delta \\ &\quad - [8.5930 - 20]n^2 m (1 + 3 \tan^2 \delta) \\ &\quad + [2.6765 - 20]n^4 \tan \delta (1 + 3 \tan^2 \delta) \\ &\quad - [3.2788 - 20]n^2 m^2 \tan \delta (2 + 3 \tan^2 \delta) \\ \cos \delta (a' - a) &= n + [4.685575 - 10]nm \tan \delta \\ &\quad - [8.8940 - 20]n^3 \tan^2 \delta \\ &\quad + [8.8940 - 20]nm^2 (1 + 3 \tan^2 \delta) \\ &\quad - [3.5796 - 20]n^3 m \tan \delta (1 + 3 \tan^2 \delta) \\ &\quad + [3.5796 - 20]nm^3 \tan \delta (2 + 3 \tan^2 \delta). \end{aligned}$$

For the declination of μ Cassiopeiæ these become

$$\begin{aligned} \delta' - \delta &= m - [4.527934 - 10]n^2 - [9.4259 - 20]n^2 m \\ &\quad + [3.6528 - 20]n^4 - [4.3146 - 20]n^2 m^2 \\ a' - a &= [0.233837]n + [5.062801 - 20]nm \\ &\quad - [9.4146 - 20]n^3 + [9.9607 - 20]nm^2 \\ &\quad - [4.7897 - 20]n^3 m + [4.8492 - 20]nm^3. \end{aligned}$$

After the differences of right ascension and declination were calculated, the small corrections $y \sec \delta$ and z , spoken of in connection with the *scale value*, were applied.

The right ascensions and declinations were then tabulated according to right ascensions. Each star was given two numbers: the first column contains the consecutive numbers; the second, the numbers given by Rutherford and which are used in Tables XX and XXI, but which are not in order of right ascension.

The precession and secular variation were found and are tabulated with each star.

In conclusion, I wish to express my obligation to Professor Jacoby for his many helpful suggestions. He was ready at all times to discuss different parts of the paper and to give me the advantage of his intimate knowledge of photographic astronomy. I am also indebted to him for placing the Rutherford measures in my hands, thus making this reduction possible.

I wish to thank Professor Rees for his interest in the work, for the encouragement he gave me at all times, and for securing the publication of this paper.

TABLE XX.

Star 1.		Re-	Aberra-	Division	Cor-	Proper	Cor-	Parallax	Corr.	Final
Plate	Measured	fract'n.	tion.	Error.	rected	Motion.	rected	Coeffi-	for	Corrected
No.	Distance.				s.		for	cient.	Paral-	Distance
							p. m.		lax,	in Arc.
31	126.3360	.0553	+.0090	+.0039	.3918	+.1281	.5199	—1.003	.5110	3544.58
32	.3524	.0471	+ 90	38	.3999	.1281	.5280	—1.003	.5191	3544.57
34	.3596	.0572	+ 91	38	.4173	.1263	.5436	—1.000	.5347	3545.15
38	.4226	.0595	+ 90	38	.4825	+ 0373	.5198	—1.003	.5109	3544.64
40	.4368	.0509	— 81	38	.4710	— .0005	.4705	+ .906	.4786	3544.11
41	.4416	.0656	— 81	38	.4905	.0005	.4900	+ .906	.4981	3544.38
42	.4654	.0382	— 83	39	.4868	.0012	.4856	+ .923	.4938	3544.42
43	.5241	.0542	+ 89	39	.5787	.0492	.5295	— .999	.5206	3544.74
47	.5439	.0450	— 84	26	.5707	.0906	.4801	+ .932	.4884	3544.38
48	.5342	.0512	— 86	18	.5662	.0913	.4749	+ .945	.4833	3543.99
49	.5273	.0591	— 86	28	.5682	.0913	.4769	+ .945	.4853	3544.05
50	.5387	.0459	— 86	31	.5667	.0916	.4751	+ .950	.4835	3543.93
57	.6352	.0509	— 68	38	.6707	.1754	.4953	+ .788	.5023	3544.81
58	.6315	.0600	— 68	38	.6761	.1754	.5007	+ .788	.5077	3544.97
59	.6641	.0405	— 71	38	.6889	.1761	.5128	+ .815	.5200	3545.09
60	126.6797	.0432	— 71	+.0038	.7072	— .1761	.5311	+ .815	.5383	3545.68
Mean										3544.593
Star 2.										
31	126.4867	.0614	+.0090	.0039	.5486	+.1915	.7401	— .632	.7345	3550.85
32	.4946	.0450	+ 90	38	.5400	+.1915	.7315	— .631	.7259	3550.36
40	.6335	.0532	— 82	34	.6695	— .0007	.6688	+ .738	.6754	3549.73
41	.6436	.0607	— 82	34	.6871	.0007	.6864	+ .738	.6930	3549.84
42	.6565	.0418	— 84	39	.6814	.0018	.6796	+ .723	.6860	3549.81
47	.7771	.0488	— 85	18	.8068	.1353	.6715	+ .712	.6778	3549.68
48	.7616	.0530	— 86	18	.8078	.1364	.6714	+ .694	.6776	3549.43
49	.7578	.0570	— 86	28	.7966	.1364	.6602	+ .694	.6664	3549.12
50	.7759	.0495	— 87	31	.8074	.1368	.6706	+ .687	.6767	3549.34
57	.9088	.0519	— 68	29	.9444	.2617	.6827	+ .780	.6896	3550.06
58	.8987	.0526	— 68	29	.9321	.2617	.6704	+ .780	.6773	3549.72
59	.9322	.0410	— 71	29	.9566	.2628	.6938	+ .774	.7007	3550.32
60	126.9528	.0470	— .0071	.0029	.9832	— .2628	.7204	+ .774	.7273	3550.97
Mean										3549.941
Star 3.										
32	134.9361	.0464	+.0096	.0010	.9777	+.1901	.1678	— .537	.1630	3786.74
40	135.0580	.0563	— 87	10	.912	— .0007	.0905	+ .670	.0965	3785.59
47	.1844	.0513	— 90	13	.2126	.1343	.0783	+ .637	.0840	3785.24
48	.2010	.0547	— 92	5	.2316	.1353	.0963	+ .616	.1018	3785.47
50	.1894	.0521	— 92	6	.2175	.1358	.0817	+ .607	.0871	3784.99
57	135.3743	.0535	— .0072	.0013	.4065	— .2598	.1467	+ .734	.1532	3787.22
Mean										3785.875
Star 4.										
57	109.4580	.0461	— .0058	.0114	.5015	— .2174	.2841	+ .848	.2916	3062.55
59	.4784	.0355	— .0061	.0123	.5119	— .2183	.2936	+ .867	.3013	3062.62
Mean										3062.585

TABLE XXI.—*Continued.*

Star 1.		Re-	Zero,	Corr.	Proper	ρ .	Corr.	Parallax	Corr.	Final
Plate	$270^{\circ} + \rho'$.	fract'n.	etc.	ρ .	Motion.		for	Coeffi-	for	corrected
No.							Orient.	cient.	Paral-	Angle.
									lax.	
31	246° 40' 24"	+22"	18' 8"	58' 54"	+3' 59"	2' 59"	4' 45"	+ 3	4 46	4 37
32	39 47	+ 8	18 21	58 16	3 59	2 15	4 17	3	4 18	3 53
34	39 46	+23	19 32	59 41	3 55	3 36	4 46	7	4 48	4 59
38	43 49	+28	19 35	3 52	+1' 4"	3 56	4 27	3	4 28	3 47
40	42 36	+12	21 46	4 34	— 1	4 33	4 48	11	4 51	4 24
41	44 3	+13	20 2	4 18	1	4 17	4 25	11	4 28	4 42
42	44 49	+ 3	19 59	4 51	2	4 49	4 3	9	4 5	3 59
43	47 8	+18	19 52	7 18	1 31	5 47	5 57	0	5 57	5 41
47	49 28	+ 9	18 42	8 19	2 48	5 21	4 19	0	4 19	4 12
48	49 28	+11	17 45	7 24	2 50	4 34	4 30	5	4 31	4 21
49	48 20	+12	17 40	6 12	2 50	3 22	4 6	5	4 7	3 55
50	47 56	+ 9	17 42	5 47	2 50	2 57	4 6	4	4 7	4 6
57	51 26	+11	17 43	9 20	5 32	3 48	4 27	20	4 32	3 55
58	51 58	+12	17 57	10 7	5 32	4 35	4 28	20	4 33	4 2
59	53 1	+ 4	17 50	10 55	5 33	5 22	4 48	18	4 53	4 20
60	54 20	+ 7	17 49	12 16	—5 33	6 43	5 27	+18	5 31	4 35
Mean										247° 4' 20.5
Star 2.										
31	295 7 35	—11	18 8	25 32	+ 4	25 36	27 28	+45	27 39	27 30
32	7 4	—10	18 21	25 15	+ 4	25 19	27 21	+45	27 32	27 7
40	6 49	— 9	21 46	28 26	— 0	28 26	28 41	—32	28 33	28 6
41	7 58	—23	20 2	27 37	0	27 37	27 45	32	27 37	27 51
42	8 12	+ 1	19 59	28 12	0	28 12	27 26	34	27 18	27 12
47	10 8	— 3	18 42	28 47	3	28 44	27 42	36	27 33	27 26
48	10 48	— 9	17 45	28 24	3	28 21	28 17	38	28 8	27 58
49	9 36	—16	17 40	27 0	3	26 57	27 41	38	27 32	27 20
50	8 55	— 4	17 42	26 33	3	26 30	27 39	38	27 30	27 29
57	10 0	—10	17 43	27 33	6	27 27	28 6	21	28 1	27 24
58	10 54	—18	17 57	28 33	6	28 27	28 20	21	28 15	27 44
59	11 8	+ 1	17 50	28 59	6	28 53	28 19	23	28 13	27 40
60	12 23	— 1	17 49	30 11	— 6	30 5	28 49	—23	28 43	27 47
Mean										295° 27' 34.9
Star 3.										
32	301 41 46	—11	18 21	59 56	—29	59 27	1 29	+46	1 41	1 16
40	40 49	—11	21 46	2 24	+ 0	2 24	2 39	—34	2 30	2 3
47	44 12	— 5	18 42	2 49	20	3 9	2 7	38	1 57	1 50
48	44 34	—11	17 45	2 8	20	2 28	2 24	39	2 14	2 4
50	43 8	— 6	17 42	0 44	21	1 5	2 14	40	2 4	2 3
57	43 22	—12	17 43	0 53	+40	1 33	2 12	—24	2 6	1 29
Mean										302° 1' 47.5
Star 4.										
57	260 51 50	+ 4	17 43	9 37	—4 49	4 48	5 27	+10	5 29	4 52
59	53 6	+ 4	17 50	11 0	—4 50	6 10	5 36	+ 7	5 38	5 5
Mean										261° 4' 58.5

TABLE XX.—Continued.

Star 5.										
Plate No.	Measured Distance.	Re-fract'n.	Aberra-tion.	Division Error.	Cor-rected s.	Proper Motion.	Cor-rected for p. m.	Parallax Coeffi-cient.	Corr. for Paral-lax.	Final Corrected Distance in Arc.
32	111.3841	.0412	+ .0079	.0108	.4354	+ .1892	.6246	— .750	.6179	3127.10
42	.5652	.0365	— 73	.0107	.5965	— .0018	.5947	+ .811	.6019	3127.14
48	.6809	.0480	— 75	.0098	.7236	— .1347	.5889	+ .791	.5959	3126.85
50	.6880	.0441	— 75	.0102	.6962	— .1351	.5611	+ .793	.5681	3126.01
57	.8076	.0473	— 60	.0104	.8507	— .2585	.5922	+ .830	.5996	3127.21
59	.8288	.0385	— 62	.0106	.8631	— .2596	.6035	+ .832	.6109	3127.34
60	111.8342	.0414	— .0062	.0122	.8730	— .2596	.6134	+ .831	.6208	3127.68
Mean										3127.047
Star 6.										
32	109.8950	.0376	+ .0078	.0127	.9449	+ .1059	.0508	— .999	.0419	3082.94
40	.9714	.0426	— 71	127	.0114	— .0004	.0110	+ .868	.0187	3082.88
42	109.9933	.0330	— 72	123	.0232	— .0010	.0222	+ .891	.0301	3083.10
48	110.0385	.0428	— 75	116	.0772	— .0756	.0016	+ .921	.0098	3082.41
57	.1377	.0422	— 59	118	.1776	— .1451	.3325	+ .729	.3390	3083.48
58	.1316	.0497	— 59	118	.1800	— .1451	.0349	+ .729	.0414	3083.56
59	.1539	.0343	— 62	122	.1860	— .1457	.0403	+ .761	.0471	3083.52
60	110.1584	.0362	— .0062	.0122	.1924	— .1457	.0467	+ .761	.0535	3083.76
Mean										3083.206
Star 7.										
32	71.4121	.0273	+ .0051	.0124	.4548	+ .1806	.6354	— .854	.6278	2006.73
42	.6017	.0230	— 47	120	.6299	— .0017	.6282	+ .879	.6360	2007.28
44	.6660	.0296	+ 51	120	.7106	— .0787	.6319	— .871	.6242	2006.68
48	.7036	.0311	— 48	117	.7395	— .1286	.6109	+ .870	.6186	2006.71
50	.7026	.0281	— 49	118	.7355	— .1290	.6065	+ .868	.6142	2006.55
57	.8230	.0307	— 39	114	.8591	— .2469	.6122	+ .857	.6198	2006.91
58	.8248	.0350	— 39	118	.8656	— .2469	.6187	+ .857	.6263	2007.10
59	.8340	.0243	— 40	118	.8640	— .2479	.6161	+ .867	.6238	2006.90
60	.8315	.0264	— .0040	.0122	.8640	— .2479	.6161	+ .866	.6238	2006.94
Mean										2006.867
Star 8.										
31	60.7565	.0305	+ .0044	.0102	.8002	+ .1760	.9762	— .892	.9683	1708.20
32	.7590	.0233	+ 44	102	.7955	+ .1760	.9715	— .891	.9636	1707.96
33	.7634	.0358	+ 44	104	.8126	+ .1734	.9860	— .856	.9784	1708.43
34	.7569	.0317	+ 44	100	.8016	+ .1734	.9750	— .856	.9674	1708.14
38	.8737	.0341	+ 44	104	.9212	+ .0511	.9723	— .893	.9641	1708.13
40	.9112	.263	— 39	108	.9430	— .0007	.9123	+ .899	.9503	1707.91
41	.9107	.323	— 39	100	.9477	— .0007	.9470	+ .899	.9550	1707.91
42	.9369	.194	— 40	104	.9613	— .0016	.9597	+ .900	.9685	1708.37
43	61.0080	.290	+ 43	104	.0503	— .0674	.9829	— .906	.9740	1708.31
44	.0296	.252	+ 43	104	.0681	— .0674	1.0007	— .906	.9918	1708.80
45	.0094	.278	+ 43	104	.0505	— .0678	.9827	— .902	.9739	1708.43
46	.0122	.242	+ 43	104	.0497	— .0678	.9819	— .902	.9731	1708.34
47	.0408	.234	— 41	98	.0685	— .1244	.9441	+ .900	.9529	1707.99
48	.0333	.265	— 42	99	.0641	— .1254	.9387	+ .896	.9475	1707.71
49	.0458	.298	— 42	99	.0799	— .1254	.9545	+ .896	.9634	1708.16
50	.0490	.238	— 42	99	.0771	— .1257	.9514	+ .894	.9603	1708.04
51	.1128	.244	+ 42	106	.1606	— .1885	.9721	— .918	.9639	1708.11
53	.1286	.267	+ 43	99	.1681	— .1905	.9776	— .899	.9696	1708.35
57	.1708	.262	— 33	100	.2023	— .2406	.9617	+ .860	.9693	1708.46
58	.1682	.299	— 33	106	.2040	— .2406	.9634	+ .860	.9710	1708.52
59	.1694	.204	— 34	104	.1954	— .2416	.9538	+ .871	.9615	1708.14
60	.1810	.0223	— .0034	.0104	.2089	— .2416	.9673	+ .871	.9750	1708.56
Mean										1708.226

TABLE XXI.—*Continued.*

Star 5.		Re-	Zero,	Corr.	Proper	p .	Corr.	Parallax	Corr.	Final
Plate	$270^{\circ} \dots \rho'$	fract'n	etc.	ρ .	Motion.		for	Coeffi-	for	corrected
No.							Orient.	cient.	Paral-	Angle.
									ax.	
32	285° 39' 55"	-8"	18 21	58 8"	+1' 2"	59 10"	1 12"	+44	1 23	0 58
42	42 44	+2	19 59	2 45	— 1	2 44	1 58	-30	1 51	1 45
48	45 12	-6	17 45	2 51	44	2 7	2 3	35	1 54	1 44
50	43 52	-1	17 42	1 33	44	0 49	1 58	36	1 49	1 48
57	45 27	-6	17 43	3 4	-1 26	1 38	2 17	15	2 13	1 36
59	46 26	+2	17 50	4 18	-1 26	2 52	2 18	18	2 13	1 40
60	47 15	+1	17 49	5 5	-1 26	3 39	2 23	-18	2 18	1 22
Mean										286° 1' 33.3
32	238 11 18	+ 9	18 21	29 48	+4 57	34 45	36 47	- 7	36 45	36 20
40	14 3	+13	21 46	36 2	— 1	36 1	36 16	+21	36 21	35 54
42	17 7	+ 2	19 59	37 8	3	37 5	36 19	19	36 24	36 18
48	23 0	+13	17 45	40 58	3 37	37 21	37 17	15	37 21	37 11
57	25 44	+13	17 43	43 40	7 4	36 36	37 15	31	37 23	36 46
58	26 14	+16	17 57	44 27	7 4	37 23	37 16	31	37 24	36 53
59	26 38	+ 4	17 50	44 32	7 6	37 26	36 52	29	36 59	36 26
60	27 43	+ 7	17 49	45 39	-7 6	38 33	37 17	+29	37 24	36 28
Mean										238° 36' 32.0
32	275 11 22	-4	18 21	29 39	+3 10	32 49	34 51	+53	35 4	34 39
42	16 35	+3	19 59	36 37	-0 2	36 35	35 49	-32	35 41	35 35
44	15 6	-3	21 30	36 33	1 13	35 20	35 35	+50	35 47	35 35
48	20 34	+0	17 45	38 19	2 15	36 4	36 0	-38	35 50	35 40
50	18 18	+2	17 42	36 2	2 16	33 46	34 55	40	34 45	34 44
57	21 8	-1	17 43	38 50	4 23	34 27	35 6	8	35 4	34 27
58	21 54	-7	17 57	39 44	4 23	35 21	35 14	8	35 12	34 41
59	22 30	+3	17 50	40 23	4 24	35 59	35 25	12	35 22	34 49
60	23 2	+3	17 49	40 54	-4 24	36 30	35 14	-12	35 11	34 15
Mean										275° 34' 56.1
31	271 23 48	+ 6	18 8	42 2	+4 23	46 25	48 17	+56	48 31	48 22
32	21 46	- 2	18 21	40 5	4 23	44 28	46 30	+56	46 44	46 19
33	21 46	+15	22 11	44 12	4 19	48 31	47 54	+64	48 10	47 54
34	22 59	+ 7	19 32	42 38	4 19	46 57	48 7	+64	48 23	48 34
38	26 28	+11	19 35	46 14	+1 10	47 24	47 55	+55	48 9	47 28
40	25 45	+ 2	21 46	47 33	— 1	47 32	47 47	-26	47 41	47 14
41	28 20	- 7	20 2	48 15	1	48 14	48 22	-26	48 16	48 30
42	29 23	+ 3	19 59	49 25	2	49 23	48 37	-30	48 29	48 23
43	29 34	+ 4	19 52	49 30	1 40	47 50	48 0	+51	48 13	47 57
44	27 46	- 1	21 30	49 15	1 40	47 35	47 50	+51	48 3	47 51
45	31 22	+ 1	19 40	51 3	1 41	49 22	48 39	+52	48 52	48 37
46	24 37	- 2	21 30	46 5	1 41	44 24	47 57	+52	48 10	47 52
47	33 18	+ 4	18 42	52 4	3 5	48 59	47 57	-33	47 49	47 42
48	34 2	+ 1	17 45	51 48	3 6	48 42	48 38	-38	48 28	48 18
49	33 18	- 3	17 40	50 55	3 6	47 49	48 33	-38	48 23	48 11
50	32 50	+ 4	17 42	50 36	3 7	47 29	48 38	-39	48 28	48 27
51	36 16	- 2	17 52	54 6	4 40	49 26	48 12	+45	48 23	48 10
53	36 50	- 0	17 38	54 28	4 43	49 45	48 30	+53	48 43	48 6
57	35 58	+ 1	17 43	53 42	6 4	47 38	48 17	- 2	48 17	47 40
58	36 6	- 5	17 57	53 58	6 4	47 54	47 47	- 2	47 47	47 16
59	36 47	+ 4	17 50	54 41	6 5	48 36	48 2	- 7	48 0	47 27
60	37 24	+ 4	17 49	55 17	-6 5	49 12	47 56	- 7	47 54	46 58
Mean										271° 47' 52.5

TABLE XX.—*Continued.*

Star 9.		Re-	Aberra-	Division	Cor-	Proper	Cor-	Parallax	Corr.	Final
Plate	Measured	fract'n	tion.	Error.	rected	Motion.	rected	Coeffi-	for	Corrected
No.	Distance.				s.		for	cient.	Paral-	Distance
							p. m.		lax.	in Arc.
31	114.6670	.0346	+.0082	.0116	.7121	+.0177	.7298	— .832	.7224	3214.29
32	.6882	355	+ 82	115	.7341	+.0177	.7518	— .832	.7444	3214.69
33	.6844	347	+ 83	115	.7296	+.0174	.7470	— .879	.7392	4.65
34	.6879	354	+ 83	115	.7338	+ 174	.7512	— .879	.7434	4.79
36	.7100	345	+ 77	115	.7544	+ 58	.7602	— .713	.7539	5.35
37	.7186	349	+ 77	115	.7634	+ 58	.7692	— .714	.7629	4.98
38	.7036	354	+ 82	115	.7494	+ 52	.7546	— .831	.7472	5.04
40	.7017	375	— 74	118	.7343	— 1	.7342	+ .617	.7397	5.17
41	.6930	450	— 74	118	.7331	— 1	.7330	+ .617	.7385	4.88
42	.7089	339	— 76	115	.7374	— 2	.7372	+ .651	.7420	5.13
43	.7234	351	+ 81	115	.7688	— 68	.7620	— .804	.7549	5.10
44	.7376	358	+ 81	115	.7837	— 68	.7769	— .804	.7698	5.48
45	.7198	356	+ 82	112	.7655	— 68	.7587	— .813	.7515	5.22
46	.7187	360	+ 82	112	.7648	— 68	.7580	— .813	.7508	5.08
47	.7202	356	— 77	108	.7496	— 127	.7369	+ .673	.7429	5.26
48	.7007	377	— 78	112	.7325	— 128	.7197	+ .705	.7260	4.55
49	.7076	413	— 78	111	.7429	— 128	.7301	+ .705	.7363	4.84
50	.7136	360	— 79	108	.7432	— 128	.7304	+ .779	.7373	4.81
51	.7208	358	+ 80	115	.7668	— 192	.7476	— .767	.7408	4.85
52	.7370	356	+ 82	115	.7830	— 195	.7635	— .819	.7562	4.98
53	.7089	362	+ 82	112	.7552	— 195	.7357	— .819	.7284	4.66
54	.7446	331	+ 82	115	.7881	— 195	.7686	— .835	.7612	5.38
55	.7301	347	+ 82	115	.7752	— 195	.7557	— .835	.7483	5.28
56	.7164	354	+ 82	112	.7619	— 195	.7424	— .835	.7350	5.01
57	.7306	367	— 62	115	.7633	— 246	.7387	+ .426	.7425	5.28
58	.7314	412	— 62	115	.7686	— 246	.7440	+ .426	.7478	5.44
59	.7368	347	— 65	118	.7675	— 247	.7428	+ .467	.7409	5.21
60	.7492	0.351	— .0065	.0118	.7803	— .0247	.7556	+ .467	.7597	3215.64
Mean										3215.937
Star 10.										
31	88.4266	.0296	+.0063	.0124	.4706	+.0531	.5237	— .924	.5155	2480.03
32	.4414	290	+ 63	128	.4852	+ 531	.5383	— .924	.5301	80.27
33	.4378	302	+ 64	128	.4829	+ 523	.5352	— .956	.5267	80.25
34	.4378	304	+ 64	124	.4827	+ 523	.5350	— .956	.5265	80.26
38	.4516	305	+ 63	128	.4969	+ 155	.5124	— .922	.5042	79.75
40	.4628	302	— 57	128	.4958	— 2	.4956	+ .735	.5021	79.95
41	.4500	384	— 57	128	.4912	— 2	.4910	+ .735	.4975	79.63
42	.4754	290	— 58	124	.5067	— 5	.5062	+ .766	.5130	80.18
45	.4936	300	+ 63	124	.5380	— 5	.5375	— .908	.5294	80.50
47	.5011	282	— 59	124	.5315	— 378	.4937	+ .785	.5007	79.91
48	.4891	298	— 60	130	.5216	— 381	.4835	+ .813	.4907	79.46
50	.5055	285	— 61	128	.5364	— 382	.4982	+ .823	.5055	79.83
51	.5152	294	+ 62	124	.5589	— 573	.5016	— .872	.4938	79.45
52	.5234	304	+ 63	124	.5682	— 579	.5103	— .914	.5022	79.45
57	.5350	302	— 47	128	.5690	— 732	.4958	+ .559	.5008	79.94
58	.5348	348	— 47	128	.5734	— 732	.5002	+ .559	.5052	80.08
59	.5419	267	— 50	128	.5721	— 735	.4986	+ .597	.5039	79.88
60	.5466	.0274	— .0050	.0128	.5775	— .0735	.5040	+ .597	.5093	2480.68
Mean										2479.935

TABLE XXI.—*Continued.*

Star 9.		Re-	Zero,	Corr.	Proper	p .	Corr.	Parallax	Corr.	Final
Plate	$270^{\circ} + p'$.	fract'n.	etc.	p .	Motion.		for	Coeffi-	for	corrected
No.							Orient.	cient.	Paral.	Angle.
31	209 53 58	+16	18 8	12 22	+5 50	18 12	20 4	-36	19 55	19 46
32	54 34	+11	18 21	13 6	5 50	18 56	20 58	-36	20 49	20 24
33	53 30	+18	22 11	15 59	5 45	21 44	21 7	-32	20 59	20 43
34	54 10	+17	19 32	13 59	5 45	19 44	20 54	-32	20 46	20 57
36	59 57	+17	19 55	20 9	1 55	22 4	21 24	-43	21 13	20 30
37	57 28	+14	20 12	17 54	1 55	19 49	21 4	-43	20 53	21 5
38	59 32	+17	19 35	19 24	+1 33	20 57	21 28	-36	21 19	20 38
40	58 52	+10	21 46	20 48	— 1	20 47	21 2	+44	21 13	20 46
41	59 56	+24	20 2	20 22	1	20 21	20 29	+44	20 40	20 54
42	210 1 28	— 1	19 59	21 26	3	21 23	20 37	+43	20 48	20 42
43	3 10	+16	19 52	23 18	2 14	21 4	21 14	-38	21 4	20 48
44	0 50	+13	21 30	22 33	2 14	20 19	20 34	-38	20 24	20 12
45	3 56	+14	19 40	23 50	2 15	21 35	20 52	-37	20 43	20 28
46	209 58 24	+12	21 30	20 6	2 15	17 51	21 24	-37	21 15	20 57
47	210 7 21	+ 4	18 42	26 7	4 7	22 0	20 58	+42	21 8	21 1
48	7 4	+11	17 45	25 0	4 9	20 51	20 47	+41	20 57	20 47
49	6 24	+18	17 40	24 22	4 9	20 13	20 57	+41	21 7	20 55
50	6 4	+ 5	17 42	23 51	4 10	19 41	20 50	+40	21 0	20 59
51	10 36	+12	17 52	28 40	6 14	22 26	21 12	-40	21 2	20 49
52	11 9	+16	17 43	29 8	6 18	22 50	20 49	-37	20 40	20 31
53	11 16	+14	17 38	29 8	6 18	22 50	21 35	-37	21 26	20 26
54	12 29	+17	17 20	30 6	6 20	23 46	21 30	-36	21 21	20 46
55	12 54	+18	17 27	30 39	6 20	24 19	21 39	-36	21 30	21 17
56	10 42	+15	17 32	28 29	6 20	22 9	21 36	-36	21 27	20 50
57	10 48	+11	17 43	28 42	8 6	20 36	21 15	+48	21 27	20 50
58	11 34	+19	17 57	29 50	8 6	21 44	21 37	+48	21 49	21 18
59	12 6	+ 0	17 50	29 56	8 8	21 48	21 14	+47	21 26	20 53
60	12 53	+ 2	17 49	30 44	-8 8	22 36	21 20	+47	21 32	20 36
Mean										210°20'44.6
Star 10.										
31	220 43 19	+21	18 8	1 48	1 7 16	9 4	10 56	-33	10 48	10 39
32	43 33	+11	18 21	2 5	7 16	9 21	11 23	-33	11 15	10 50
33	41 52	+27	22 11	4 30	7 9	11 39	11 2	-27	10 55	10 39
34	42 1	+23	19 32	1 56	7 9	9 5	10 15	-27	10 8	10 19
38	48 8	+25	19 35	8 8	+ 1 56	10 4	10 35	-33	10 27	9 46
40	49 4	+12	21 46	11 2	— 2	11 0	11 15	+47	11 27	11 0
41	50 6	+25	20 2	10 33	2	10 31	10 39	+47	10 51	11 5
42	51 44	+ 1	19 59	11 44	4	11 40	10 54	+44	11 5	10 59
45	54 22	+18	19 40	14 20	2 48	11 32	10 49	-35	10 40	10 25
47	58 8	+ 7	18 42	16 57	5 8	11 49	10 47	+43	10 58	10 51
48	58 0	+13	17 45	15 58	5 10	10 48	10 44	+50	10 56	10 46
50	57 6	+ 8	17 42	14 56	5 11	9 45	10 54	+41	11 4	11 3
51	221 1 58	+13	17 52	20 3	7 46	12 17	11 3	-39	10 53	10 40
52	3 4	+21	17 43	21 8	7 51	13 17	11 16	-34	11 7	10 58
57	3 16	+14	17 43	21 13	10 5	11 8	11 47	+54	12 1	11 24
58	3 4	+21	17 57	21 22	10 5	11 17	11 10	+54	11 24	10 53
59	3 45	+ 2	17 50	21 37	10 8	11 29	10 55	+53	11 8	10 35
60	4 44	+ 5	17 49	22 38	-10 8	12 30	11 14	+53	11 27	10 31
Mean										221°10'44.6

TABLE XX.—Continued.

Star 11.		Re-	Aberra-	Division	Cor-	Proper	Cor-	Parallax	Corr.	Final
Plate	Measured	fract' n.	tion.	Error.	rected	Motion.	rected	Coeffi-	for	Corrected
No.	Distance.				s.		for	cient.	Paral-	Distance
							p. m.		lax.	in Arc.
31	126.3518	.0448	+.0090	.0048	.3980	+.1524	.5504	— .036	.5501	3545.68
32	.3496		+ 90	38	.3864	+.1525	.5389	— .035	.5386	5.12
33	.3440	534	+ 91	38	.3979	+.1502	.5481	+ .046	.5485	5.51
40	.4830	427	— 81	38	.5090	— 6	.5084	+ .255	.5106	5.00
41	.4866	421	— 81	38	.5120	— 6	.5114	+ .255	.5136	4.81
42	.4919	407	— 83	48	.5167	— 14	.5153	+ .223	.5173	5.08
43	.5420	427	+ 89	39	.5851	— 584	.5267	— .077	.5260	4.89
47	.5948	433	— 85	34	.6206	— .1077	.5129	+ .200	.5147	5.12
48	.5992	426	— 86	29	.6237	— .1086	.5151	+ .164	.5165	4.92
49	.5965	426	— 86	39	.6220	— .1086	.5134	+ .164	.5148	4.87
50	.5768	436	— 87	39	.6032	— .1089	.4943	+ .153	.4957	4.27
52	.6430	452	+ 90	39	.6887	— .1650	.5237	— .056	.5232	4.64
57	.6829	415	— 68	38	.7090	— .2084	.5006	+ .407	.5042	4.86
58	.6784	408	— 68	38	.7038	— .2084	.4954	+ .407	.4990	4.73
59	.6739	420	— 71	38	.7002	— .2093	.4909	+ .378	.4943	4.37
60	.6826	.0429	— .0071	.0038	.7098	— .2093	.5005	+ .378	.5039	3544.72
Mean										3544.912
Star 12.										
31	57.8638	.0293	+.0041	.0095	.9056	+.1863	.0919	— .800	.0848	1627.42
32	.8669	218	+ 41	94	.9011	+.1863	.0874	— .799	.803	7.18
33	.8659	350	+ 42	97	.9137	+.1836	.0973	— .751	.906	7.52
34	.8651	304	+ 42	92	.9078	+.1836	.0914	— .751	.847	7.37
41	58.0360	301	— 37	96	.0709	— 7	.0702	+ .849	.778	7.29
42	.0465	188	— 38	96	.0700	— 17	.0683	+ .844	.758	7.31
43	.1350	276	+ 41	96	.1752	— 714	.1038	— .820	.965	7.70
44	.1371	237	+ 41	96	.1734	— 714	.1020	— .820	.947	7.63
46	.1389	226	+ 41	97	.1742	— 718	.1024	— .815	.952	7.70
47	.1602	224	— 39	92	.1868	— .1316	.0552	+ .838	.626	7.00
48	.1638	251	— 40	92	.1930	— .1327	.0603	+ .828	.677	7.02
49	.1541	278	— 40	90	.1858	— .1327	.0531	+ .828	.605	6.82
50	.1755	228	— 40	91	.2023	— .1330	.0693	+ .825	.766	7.24
57	.2976	247	— 31	92	.3273	— .2546	.0727	+ .758	.794	7.48
58	.3040	276	— 31	94	.3368	— .2546	.0822	+ .758	.889	7.76
59	.2980	198	— 33	96	.3230	— .2557	.0673	+ .762	.741	7.24
60	.3208	.0214	— .0033	.0096	.3474	— .2557	.0917	+ .762	.0985	1627.95
Mean										1627.390
Star 13.										
31	68.1350	.0235	+.0049	.0122	.1738	+.0610	.2348	— 1.093	.2251	1911.53
32	.1366	227	+ 49	122	.1746	+ 610	.2356	— 1.093	.2259	1.42
34	.1354	241	+ 49	126	.1752	+ 601	.2353	— 1.111	.2254	1.48
38	.1806	243	+ 49	129	.2209	+ 178	.2387	— 1.093	.2290	1.67
41	.1688	303	— 44	118	.2047	— 2	.2045	+ .928	.2127	1.26
42	.1912	201	— 45	122	.2172	— 6	.2166	+ .965	.2252	1.70
43	.2212	237	+ 48	126	.2605	— 234	.2371	— 1.078	.2275	1.54
44	.2232	233	+ 48	122	.2617	— 234	.2383	— 1.078	.2287	1.55
46	.2178	232	+ 48	126	.2566	— 236	.2330	— 1.083	.2234	1.48
48	.2086	232	— 46	116	.2370	— 437	.1933	+ .959	.2018	0.97
50	.2209	222	— 47	126	.2292	— 438	.1854	+ 1.004	.1943	0.73
51	.2662	230	+ 47	126	.3047	— 657	.2390	— 1.055	.2297	1.69
53	.2458	238	+ 48	126	.2852	— 664	.2188	— 1.086	.2091	1.20
54	.2758	235	+ 49	126	.3150	— 667	.2483	— 1.094	.2386	1.91
57	.2672	237	— 37	126	.2980	— 840	.2140	+ .759	.2208	1.66
58	.2654	275	— 37	129	.3003	— 840	.2163	+ .759	.2231	1.73
59	.2832	207	— 38	125	.3108	— 844	.2264	+ .797	.2335	1.90
60	.2735	.0214	— .0038	.0129	.3032	— .0844	.2188	+ .797	.2259	1911.73
Mean										1911.508

TABLE XXI.—*Continued.*

Star 11.		Re-	Zero,	Corr.	Proper	p .	Corr.	Parallax	Corr.	Final
Plate	$270^\circ + p'$.	fract'n	etc.	p .	Motion.		for	Coeffi-	for	corrected
No.							Orient.	cient.	Paral-	Angle.
31	332° 3' 18"	—23	18 8	21 3	—3 2	18 1	19 53	+58	20 8	19 59
32	2 21	—8	18 21	20 34	3 2	17 32	19 34	+58	19 49	19 24
33	1 49	—34	22 11	23 26	—3 0	20 26	19 49	+59	20 4	19 48
40	331 59 16	—12	21 46	20 50	+	20 51	21 6	—52	20 53	20 26
41	332 0 15	—17	20 2	20 0	1	20 1	20 9	—52	19 56	20 10
42	1 13	—3	19 59	21 9	2	21 11	20 25	—53	20 12	20 6
43	331 59 26	—19	19 52	19 59	1 10	21 9	21 19	+58	21 35	21 19
47	332 0 35	+ 8	18 42	18 85	2 8	21 33	20 31	—53	20 18	20 11
48	0 58	—12	17 45	18 31	2 10	20 41	20 37	—54	20 26	20 16
49	0 18	—15	17 40	17 43	2 10	19 53	20 37	—54	20 26	20 14
50	331 59 40	—9	17 42	17 13	2 10	19 23	20 32	—55	20 18	20 17
52	332 1 30	—22	17 52	19 0	3 17	22 17	20 16	+58	20 31	20 22
57	331 58 44	—12	17 43	16 15	4 13	20 28	21 7	—44	20 56	20 19
58	59 29	—14	17 57	17 12	4 13	21 25	21 18	—44	21 7	20 36
59	59 29	—4	17 50	17 15	4 14	21 29	20 55	—46	20 44	20 11
60	332 0 44	+ 6	17 49	18 39	+ 4 14	22 53	21 37	—46	21 26	20 30
Mean									332° 20' 15.5	
Star 12.										
31	281 15 52	—2	18 8	33 58	+ 2 43	36 41	38 33	+77	38 52	38 43
32	15 46	—6	18 21	34 1	2 43	36 44	38 46	+77	39 5	38 35
33	15 43	+ 4	22 11	37 58	2 40	40 38	40 1	+85	40 22	40 6
34	15 14	—2	19 32	34 44	+ 2 40	37 24	38 34	+85	38 55	39 6
41	19 29	—14	20 2	39 17	— 1	39 16	39 24	—46	39 12	39 26
42	20 6	+ 3	19 59	40 8	2	40 6	39 20	—51	39 7	39 1
43	19 50	—4	19 52	39 38	1 3	38 35	38 25	+72	38 43	38 27
44	18 50	—6	21 30	40 14	1 3	39 11	39 26	+72	39 44	39 32
46	15 36	—6	21 30	37 0	1 3	35 57	39 30	+73	39 48	39 30
47	23 55	+ 1	18 42	42 38	1 56	40 42	39 40	—54	39 26	39 19
48	23 59	—4	17 45	41 40	1 57	39 43	39 39	—58	39 25	39 15
49	23 57	—9	17 40	41 28	1 57	39 31	40 15	—58	40 1	39 49
50	22 54	+ 1	17 42	40 37	1 57	38 40	39 49	—60	39 34	39 33
57	25 33	—4	17 43	43 12	3 48	39 24	40 3	—25	39 57	39 20
58	25 53	—11	17 57	43 39	3 48	39 51	39 44	—25	39 38	39 7
59	25 44	+ 3	17 50	43 37	3 49	39 48	39 14	—25	39 8	38 35
60	26 12	+ 2	17 49	44 3	—3 49	40 14	38 58	—25	38 52	37 56
Mean									281° 39' 8.2	
Star 13.										
31	223 7 38	+22	18 8	26 8	+ 9 16	35 24	37 16	—39	37 6	36 57
32	7 52	+11	18 21	26 24	9 16	35 40	37 42	—39	37 32	37 7
34	6 32	+23	19 32	26 27	9 8	35 35	36 45	—30	36 57	36 48
38	15 5	+26	19 35	35 6	+ 2 28	37 34	38 5	—39	37 55	37 14
41	16 20	+25	20 2	36 47	— 2	36 45	36 53	+57	37 7	37 21
42	18 28	+ 1	19 59	38 28	5	38 23	37 37	+54	37 50	37 44
43	20 37	+20	19 52	40 49	3 33	37 16	37 26	—42	37 16	37 0
44	19 31	+14	21 30	41 15	3 33	37 42	37 57	—42	37 47	37 35
46	15 58	+12	21 30	37 40	3 34	34 6	37 39	—41	37 29	37 11
48	26 17	+13	17 45	44 15	6 35	37 40	37 36	+49	37 48	37 38
50	24 40	+ 8	17 42	42 30	6 36	35 54	37 3	+48	37 15	37 14
51	31 35	+13	17 52	49 40	9 54	39 46	38 32	—47	38 20	38 7
53	32 5	+16	17 38	49 59	10 1	39 58	38 43	—40	38 33	37 53
54	32 17	+32	17 20	50 9	10 3	40 6	37 50	—38	37 40	37 5
57	31 56	+14	17 43	49 53	12 52	37 1	37 40	+68	37 57	37 20
58	32 24	+21	17 57	50 42	12 52	37 50	37 43	+68	38 0	37 29
59	33 16	+ 2	17 50	51 8	12 55	38 13	37 39	+66	37 56	37 23
60	33 38	+ 5	17 49	51 32	—12 55	38 37	37 39	+66	37 56	37 0
Mean									223° 37' 20.3	

TABLE XX.—*Continued.*

Star 14.										
Plate No.	Measured Distance.	Re- fract'n.	Aberra- tion.	Division Error.	Cor. rected s.	Proper Motion.	Cor- rected for p. m.	Parallax Coeffi- cient.	Corr. for Paral- lax.	Final Corrected Distance in Arc.
31	113.2081	.0391	.0080	.0111	.2573	+.1465	.4038	+.013	.4039	3177.35
32	.2208	322	+ 80	104	.2624	+.1465	.4089	+.015	.4090	7.28
33	.2124	460	+ 81	104	.2679	+.1444	.4123	+.096	.4131	7.49
34	.2099	401	+ 81	102	.2593	+.1444	.4037	+.096	.4045	7.28
36	.2933	402	+ 76	102	.3423	+ 482	.3905	-.080	.3898	7.12
38	.2980	435	+ 81	102	.3508	+ 426	.3934	+.012	.3935	7.12
40	.3463	428	- 72	104	.3833	- 6	.3827	+.212	.3846	7.20
41	.3464	370	- 72	102	.3774	- 6	.3768	+.212	.3787	6.78
42	.3603	364	- 74	110	.3913	- 14	.3899	+.178	.3915	7.29
43	.4168	372	+ 80	110	.4640	- 562	.4078	-.027	.4076	7.35
44	.4191	338	+ 80	110	.4620	- 562	.4058	-.030	.4055	7.26
45	.4054	359	+ 80	110	.4513	- 564	.3949	-.015	.3948	7.21
46	.4170	329	+ 80	107	.4596	- 564	.4032	-.015	.4031	7.32
47	.4612	381	- 75	102	.4930	-.1035	.3895	+.154	.3909	7.37
48	.4634	377	- 77	104	.4948	-.1044	.3904	+.119	.3914	7.16
49	.4632	372	- 77	104	.4941	-.1044	.3897	+.119	.3907	7.14
50	.4604	383	- 77	104	.4924	-.1046	.3878	+.106	.3887	7.03
51	.5166	332	+ 78	107	.5593	-.1569	.4024	-.077	.4017	7.33
52	.5206	394	+ 80	107	.5697	-.1586	.4111	-.007	.4111	7.29
53	.5158	350	+ 80	107	.5605	-.1586	.4019	-.007	.4019	7.49
54	.4916	544	+ 81	107	.5558	-.1592	.3966	+.017	.3968	7.15
55	.5050	421	+ 81	107	.5569	-.1592	.3977	+.017	.3979	7.44
56	.5178	366	+ 81	107	.5642	-.1592	.4050	+.017	.4051	7.75
57	.5562	367	- 61	107	.5885	-.2003	.3882	+.369	.3915	7.42
58	.5554	358	- 61	102	.5863	-.2003	.3860	+.369	.3895	7.38
59	.5614	374	- 64	102	.5936	-.2011	.3925	+.338	.3955	7.34
60	.5586	.0382	-.0064	0.102	.5916	-.2011	.3905	+.338	.3935	3177.35
Mean										3177.285
Star 15.										
31	113.8376	.0316	+.0081	.0114	.8797	-.0262	.8535	-.682	.8474	3189.78
32	.8510	328	+ 81	104	.8933	- 262	.8671	-.682	.8610	89.94
33	.8450	317	+ 82	107	.8866	- 258	.8608	-.743	.8542	89.85
34	.8500	320	+ 82	107	.8919	- 258	.8661	-.743	.8595	90.02
36	.8294	314	+ 77	107	.8702	- 86	.8616	-.542	.8568	90.21
40	.7967	354	- 73	100	.8258	+ 1	.8259	+.443	.8298	89.67
41	.7816	391	- 73	100	.8144	+ 1	.8145	+.443	.8184	89.10
42	.7946	340	- 75	110	.8231	+ 2	.8233	+.482	.8276	89.51
45	.8020	323	+ 81	112	.8446	+ 100	.8546	-.688	.8488	89.93
47	.7752	347	- 76	104	.8037	+ 184	.8221	+.505	.8266	89.58
48	.7736	352	- 78	107	.8027	+ 186	.8213	+.541	.8261	89.34
49	.7675	369	- 78	107	.7983	+ 186	.8169	+.541	.8217	89.22
50	.7731	349	- 78	107	.8019	+ 186	.8205	+.554	.8254	89.26
51	.7904	326	+ 79	107	.8326	+ 277	.8603	-.678	.8552	90.04
57	.7632	341	- 61	104	.7926	+ 353	.8279	+.244	.8301	89.71
58	.7702	364	- 61	107	.8022	+ 353	.8375	+.244	.8397	89.99
59	.7749	347	- 64	100	.8042	+ 355	.8397	+.286	.8422	89.86
60	.7726	0.344	-.0064	.0100	.8026	+.0355	.8381	+.286	.8406	3189.88
Mean										3189.716

TABLE XXI.—*Continued.*

Star 14.		Re-	Zero,	Corr.	Proper	μ .	Corr.	Parallax	Corr.	Final
Plate	270°-- μ .	fract'n	etc.	μ .	Motion.		for	Coefficient.	for	corrected
No.							Orient.		Paral-	Angle.
									lax.	
31	334° 54' 9"	-22"	18' 8"	11' 55"	-3' 38"	8' 17"	10' 9"	+65	10 25	10 16
32	53 39	7	18 21	11 53	3 38	8 15	10 17	+65	10 33	10 8
33	52 39	34	22 11	14 16	3 35	10 41	10 4	+65	10 20	10 4
34	53 43	24	19 32	12 51	3 35	9 16	10 26	+65	10 42	10 53
36	53 2	25	19 55	12 32	1 12	11 20	10 40	+63	10 56	10 13
38	51 49	29	19 35	10 55	-58	9 57	10 28	+65	10 44	10 3
40	49 30	12	21 46	11 4	+1	11 5	11 20	-58	11 3	10 36
41	50 3	14	20 2	9 51	1	9 52	10 0	-58	9 43	9 59
42	51 1	3	19 59	10 57	2	10 59	10 13	-59	9 56	9 50
43	49 8	18	19 52	8 42	1 23	10 5	10 15	+65	10 31	10 15
44	46 57	11	21 30	8 16	1 23	9 39	9 54	+65	10 10	9 58
45	49 58	16	19 40	9 22	1 24	10 46	10 3	+65	10 19	10 4
46	43 55	8	21 30	5 17	1 24	6 41	10 14	+65	10 30	10 12
47	49 56	8	18 42	8 30	2 34	11 4	10 2	-60	9 47	9 40
48	50 34	11	17 45	8 8	2 35	10 43	10 39	-61	10 24	10 14
49	49 48	13	17 40	7 15	2 35	9 59	10 34	-61	10 19	10 7
50	48 58	9	17 42	6 31	2 35	9 6	10 15	-61	10 0	9 59
51	49 32	9	17 52	7 15	3 53	11 8	9 54	+64	10 10	9 57
52	51 2	21	17 43	8 24	3 55	12 19	10 18	+65	10 34	10 25
53	50 11	13	17 38	7 36	3 55	11 31	10 16	+65	10 32	9 52
54	52 21	43	17 20	8 58	3 56	12 54	10 38	+64	10 54	10 19
55	52 2	27	17 27	9 2	3 56	12 58	10 18	+65	10 34	10 21
56	50 8	17	17 32	7 23	3 56	11 19	10 46	+65	11 2	10 25
57	47 44	12	17 43	5 15	5 2	10 17	10 56	-50	10 44	10 7
58	48 4	14	17 57	5 47	5 2	10 49	10 42	-50	10 30	9 59
59	48 55	4	17 50	6 41	5 4	11 45	11 11	-52	10 58	10 25
60	49 44	-7	17 49	7 26	+5 4	12 30	11 14	-52	11 1	10 5
Mean										335° 10' 9.9
Star 15.										
31	196° 46' 20"	-6	18' 8"	4 34	+5 51	10 25	12 17	-48	12 5	11 56
32	46 0	+8	18 21	4 29	5 51	10 20	12 22	-48	12 10	11 45
33	45 15	+3	22 11	7 29	5 46	13 15	12 38	-44	12 27	12 11
34	45 50	+7	19 32	5 29	5 46	11 15	12 25	-44	12 14	12 25
36	51 42	+6	19 55	11 43	+1 55	13 38	12 58	-53	12 45	12 2
40	50 1	+6	21 46	11 53	-1	11 52	12 7	+52	12 20	11 53
41	51 3	+19	20 2	11 24	1	11 23	11 31	+52	11 44	11 58
42	52 44	-2	19 59	12 41	3	12 38	11 52	+51	12 5	11 59
45	55 10	+8	19 40	14 58	2 15	12 43	12 0	-49	11 48	11 33
47	58 37	+1	18 42	17 20	4 8	13 12	12 10	+51	12 23	12 16
48	58 18	+6	17 45	16 9	4 10	11 59	11 55	+50	12 8	11 58
49	57 16	+13	17 40	15 9	4 10	10 59	11 43	+50	11 56	11 44
50	56 48	+1	17 42	14 31	4 11	10 20	11 29	+50	11 42	11 41
51	197° 1' 56"	+9	17 52	19 57	6 16	13 41	12 27	-51	12 14	12 1
57	2 12	+7	17 43	20 2	8 8	11 54	12 33	+53	12 46	12 9
58	2 27	+14	17 57	20 38	8 8	12 30	12 23	+53	12 36	12 5
59	3 14	-2	17 50	21 2	8 10	12 52	12 18	+53	12 31	11 58
60	4 14	-0	17 49	22 3	-8 10	13 53	12 37	+53	12 50	11 54
Mean										197° 11' 58.2

TABLE XX.—*Continued.*

Star 16.		Re- fract'n.	Aberra- tion.	Division Error.	Cor- rected s.	Proper Motion.	Cor- rected for p. m.	Parallax Coeffi- cient.	Corr. for Paral- lax.	Final Corrected Distance in Arc.
Plate No.	Measured Distance.									
31	54.8756	.0167	+ .0039	.0098	.9049	+ .0210	.9259	— .841	.9184	1538.70
32	.8908	171	+ 39	98	.9205	+ 210	.9415	— .842	.9340	9.04
33	.8878	167	+ 40	101	.9175	+ 206	.9381	— .886	.9302	8.98
34	.8905	171	+ 40	98	.9203	+ 206	.9409	— .886	.9330	9.07
36	.9058	167	+ 37	98	.9349	+ 70	.9419	— .725	.9355	9.26
37	.9072	169	+ 37	98	.9365	+ 70	.9435	— .726	.9371	9.01
38	.9068	171	+ 39	98	.9365	+ 62	.9427	— .840	.9352	9.20
40	.8947	180	— 35	98	.9179	— 1	.9178	+ .629	.9234	9.03
41	.8950	217	— 35	101	.9232	— 1	.9231	+ .629	.9287	9.06
42	.8997	162	— 36	102	.9214	— 2	.9212	+ .663	.9271	9.08
43	.9194	169	+ 39	102	.9489	— 82	.9407	— .814	.9335	9.08
44	.9167	173	+ 39	102	.9470	— 82	.9388	— .814	.9316	9.01
45	.9176	172	+ 39	98	.9474	— 82	.9392	— .831	.9318	9.13
46	.9187	173	+ 39	96	.9484	— 82	.9402	— .831	.9328	9.10
47	.9016	171	— 37	101	.9240	— 153	.9087	+ .684	.9148	8.79
48	.8898	182	— 37	99	.9131	— 154	.8977	+ .716	.9041	8.38
49	.9100	199	— 37	99	.9350	— 154	.9196	+ .716	.9260	9.00
50	.9086	173	— 38	99	.9309	— 154	.9155	+ .727	.9220	8.85
51	.9276	172	+ 38	101	.9576	— 233	.9343	— .778	.9274	8.98
52	.9306	172	+ 39	101	.9607	— 235	.9372	— .828	.9298	8.90
53	.9143	175	+ 39	100	.9446	— 235	.9211	— .828	.9137	8.66
56	.9328	161	+ 39	96	.9613	— 236	.9377	— .843	.9302	9.21
57	.9290	177	— 29	101	.9528	— 298	.9230	+ .439	.9269	9.14
58	.9354	199	— 29	98	.9611	— 298	.9313	+ .439	.9352	9.38
59	.9376	166	— 31	98	.9598	— 299	.9299	+ .480	.9342	9.26
60	.9381	.0168	— .0031	.0298	.9605	— .0299	.9306	+ .480	.9349	1539.31
Mean										1539.023
Star 17.										
42	27.0378	.0089	— .0017	+ .0106	.0556	— .0018	.0538	+ .768	.0606	758.25
50	.1535	105	— 18	— 20	.1602	— .1366	.0236	+ .758	.0303	7.36
57	.2804	110	— 15	— 12	.2887	— .2615	.0272	+ .754	.0339	7.53
58	.2852	119	— 15	+ 108	.3061	— .2615	.0449	+ .754	.0516	8.03
59	.2767	95	— 15	+ 107	.2954	— .2625	.0329	+ .761	.0397	7.65
60	.2874	.0101	— .0015	+ .0108	.3068	— .2625	.0443	+ .761	.0511	757.99
Mean										757.802

TABLE ·XXI.—*Continued.*

Star 16.		Re- fract'n.	Zero, etc.	Corr. p .	Proper Motion.	p .	Corr. for Orient.	Parallax Coeffi- cient.	Corr. for Paral- lax.	Final corrected Angle.
Plate No.	$270^{\circ} + p'$.									
31	210° 50' 51"	+17"	18' 8"	9' 16"	+12' 2"	21' 18"	23' 10"	-73	22 52	22 43
32	50 36	+10	18 21	9 7	12 2	21 9	23 11	-73	22 53	22 28
33	50 25	+19	22 11	12 55	11 51	24 46	24 9	-64	23 53	23 37
34	50 50	+18	19 32	10 40	11 51	22 31	23 41	-64	23 25	23 36
36	59 36	+17	19 55	19 48	4 10	23 58	23 18	-88	22 56	22 13
37	58 2	+14	20 12	18 28	4 10	22 38	23 53	-88	23 31	23 43
38	59 40	+18	19 35	19 33	+3 12	22 45	23 16	-73	22 58	22 17
40	211° 0' 14"	+11	21 46	22 11	— 3	22 8	22 23	+91	22 46	22 19
41	1 34	+24	20 2	22 0	3	21 57	22 5	+91	22 28	22 42
42	3 41	— 1	19 59	23 39	7	23 32	22 46	+88	23 8	23 2
43	7 56	+16	19 52	28 4	4 36	23 28	23 38	-78	23 18	23 2
44	6 49	+13	21 30	28 32	4 36	23 56	24 11	-78	23 51	23 39
45	8 53	+15	19 40	28 48	4 38	24 10	23 27	-76	23 8	22 53
46	3 22	+12	21 30	25 4	4 38	20 26	23 59	-76	23 40	23 22
47	13 50	+5	18 42	32 37	8 30	24 7	23 5	+86	23 27	23 20
48	14 23	+11	17 45	32 19	8 34	23 45	23 41	+84	24 2	23 52
49	12 10	+18	17 40	30 8	8 34	21 34	22 18	+84	22 39	22 27
50	12 27	+5	17 42	30 14	8 35	21 39	22 48	+83	23 9	23 8
51	19 34	+12	17 52	37 38	12 52	24 46	23 32	-82	23 12	22 59
52	19 58	+17	17 43	37 58	13 1	24 57	22 56	-76	22 37	22 28
53	19 20	+14	17 38	37 12	13 1	24 11	22 56	-76	22 37	21 57
56	19 46	+18	17 20	37 24	13 3	24 21	23 48	-73	23 31	22 54
57	20 46	+12	17 43	38 41	16 43	21 58	22 37	+99	23 2	22 25
58	21 43	+19	17 57	39 59	16 43	23 16	23 9	+99	23 34	23 3
59	22 14	+0	17 50	40 4	16 48	23 16	22 42	+98	23 7	22 34
60	23 31	+3	17 49	41 23	-16 48	24 35	23 19	+98	23 44	22 48
Mean									211° 22' 54.3	
Star 17.		Re- fract'n.	Zero, etc.	Corr. p .	Proper Motion.	p .	Corr. for Orient.	Parallax Coeffi- cient.	Corr. for Paral- lax.	Final corrected Angle.
Plate No.	$297^{\circ} + p'$.									
42	297° 19' 24"	+1	19 59	39 24	+0	39 24	38 38	-168	37 56	37 50
50	19 8	— 4	17 42	36 46	45	37 31	38 40	187	37 53	37 52
57	17 18	-10	17 43	34 51	1 20	36 11	36 50	125	36 19	35 42
58	17 18	-18	17 57	34 57	1 20	36 17	36 10	106	35 43	35 12
59	17 20	-0	17 50	35 10	1 20	36 30	35 56	117	35 27	34 54
60	18 46	-2	17 49	36 33	+1 20	37 53	36 37	-117	36 8	35 12
Mean									297° 36' 7.0	

TABLE XX.—*Continued.*

Star 18.		Re-	Aberra-	Division	Cor-	Proper	Cor-	Parallax	Corr.	Final
Plate	Measured	fract n.	tion.	Error.	rected	Motion.	rected	Coeffi-	for	Corrected
No.	Distance.				s.		for	cient.	Paral-	Distance
							p. m.		ax.	in Arc.
31	34.7100	.0116	+.0025	.0109	.7346	+.0535	.7881	— .924	.7799	974.46
32	.7076	.114	+ 25	112	.7323	+ 535	.7858	— .924	.7776	4.33
33	.7168	.119	+ 25	112	.7420	+ 527	.7947	— .957	.7862	4.60
34	.7063	.120	+ 25	109	.7313	+ 527	.7840	— .957	.7755	4.31
37	.7507	.116	+ 23	112	.7754	+ 178	.7932	— .827	.7858	4.49
38	.7489	.121	+ 25	112	.7743	+ 157	.7900	— .923	.7818	4.53
40	.7297	.120	— 22	112	.7503	— 2	.7501	+ .737	.7567	3.93
41	.7330	.152	— 22	112	.7568	— 2	.7566	+ .737	.7632	4.04
42	.7422	.102	— 23	109	.7606	— 5	.7601	+ .768	.7669	4.19
43	.7812	.119	+ 24	109	.8060	— 208	.7852	— .903	.7772	4.64
44	.7868	.117	+ 24	109	.8114	— 208	.7906	— .903	.7826	4.50
45	.7846	.118	+ 25	110	.8095	— 209	.7886	— .909	.7805	4.51
46	.7831	.114	+ 25	110	.8076	— 209	.7867	— .909	.7786	4.42
47	.7870	.112	— 23	109	.8064	— 385	.7679	+ .786	.7749	4.44
48	.7741	.118	— 24	110	.7941	— 388	.7553	+ .814	.7625	4.02
49	.7759	.137	— 24	110	.7978	— 388	.7590	+ .814	.7662	4.12
50	.7746	.113	— 24	110	.7941	— 389	.7552	+ .823	.7625	4.01
51	.8171	.116	+ 24	109	.8416	— 584	.7832	— .873	.7754	4.35
52	.8090	.120	+ 25	109	.8340	— 590	.7750	— .914	.7668	4.02
53	.8050	.119	+ 25	110	.8300	— 590	.7710	— .914	.7628	4.04
57	.8257	.120	— 19	112	.8466	— 747	.7719	+ .561	.7769	4.51
58	.8253	.138	— 19	112	.8494	— 747	.7747	+ .561	.7797	4.59
59	.8343	.105	— 20	112	.8536	— 750	.7786	+ .599	.7839	4.64
60	.8314	.0108	— .0020	.0112	.8510	— .0750	.7760	+ .599	.7813	974.59
Mean										974.345
Star 19.										
31	39.7553	.0142	+.0028	.0110	.7829	+.1520	.9349	— .036	.9346	1118.89
32	.7584		+ 28	114		.1520	.9357	— .035	.9354	8.83
33	.7652	.0168	+ 29	114	.7959	.1498	.9457	+ .046	.9461	9.17
34	.7522	.0146	+ 29	114	.7807	.1498	.9305	+ .046	.9309	8.75
37	.8626	.0125	+ 27	116	.8890	+.0501	.9391	— .188	.9374	8.81
40	.8916	.135	— 25	116	.9138	— .0006	.9132	+ .255	.9155	8.49
41	.9186	.133	— 25	116	.9406	6	.9400	+ .255	.9423	9.15
42	.9123	.128	— 26	114	.9335	14	.9321	+ .213	.9340	8.97
43	.9735	.135	+ 28	114	.0008	584	.9424	— .077	.9417	9.05
44	.9824	.145	+ 28	114	.0107	584	.9523	— .077	.9516	9.32
45	.9579	.130	+ 28	110	.9843	586	.9257	— .065	.9251	8.66
46	.9746	.118	+ 28	114	.0002	586	.9416	— .065	.9410	9.06
47	40.0272	.136	— 27	116	.0493	.1077	.9416	+ .200	.9434	9.27
48	.0276	.134	— 27	110	.0489	.1085	.9404	+ .164	.9418	9.14
49	.0257	.134	— 27	110	.0470	.1085	.9385	+ .164	.9399	9.09
50	.0236	.138	— 27	110	.0453	.1088	.9365	+ .153	.9379	9.01
51	.0684		+ 28	116		.1633		— .125	.9298	8.77
52	.0793	.142	+ 28	116	.1079	.1650	.9425	— .056	.9420	9.00
57	.1167	.131	— 22	116	.1388	.2084	.9304	+ .407	.9340	9.02
58	.1172	.129	— 22	116	.1391	.2084	.9307	+ .407	.9343	9.03
59	.1127	.133	— 22	116	.1350	.2092	.9258	+ .378	.9292	8.81
60	.1040	.0136	— .0022	.0116	.1266	— .2092	.9174	+ .378	.9208	1118.60
Mean										1118.950

TABLE XXI.—*Continued.*

Star 18.			Re-	Zero,	Corr.	Proper	ρ .	Corr.	Parallax	Corr.	Final
Plate	$270^\circ + \rho'$	fract'n.	etc.	ρ .	Motion.	ρ .	for	Coefi-	for	corrected	
No.							Orient.	cient.	Paral-	Angle.	
31	220° 42' 14"	+21	18' 8"	0' 43"	+18 18	19' 1"	20' 53"	— 84	20 32	20 23	
32	41 4	11	18 21	59 36	18 18	17 54	19 56	— 84	19 35	19 10	
33	40 46	27	22 11	3 24	18 2	21 26	20 49	— 67	20 32	20 16	
34	41 11	23	19 32	1 6	18 2	19 8	20 18	— 67	20 1	20 12	
37	52 17	17	20 12	12 46	6 1	18 47	20 2	—110	19 34	19 46	
38	53 8	25	19 35	13 8	+ 4 52	18 0	18 31	— 84	18 10	17 29	
40	57 22	12	21 46	19 20	— 4	19 16	19 31	+118	20 0	19 33	
41	59 36	25	20 2	20 3	4	19 59	20 7	+118	20 36	20 50	
42	221 1 24	1	19 59	21 24	10	21 14	20 28	+113	20 56	20 50	
43	7 6	20	19 52	27 18	7 0	20 18	20 28	— 91	20 5	19 49	
44	6 15	14	21 30	27 59	7 0	20 59	21 14	— 91	20 51	20 39	
45	9 41	18	19 40	28 39	7 2	21 37	20 53	— 89	20 31	20 16	
46	2 30	13	21 30	24 13	7 2	17 11	20 44	— 89	20 22	20 4	
47	15 26	7	18 42	34 15	12 54	21 21	20 19	+110	20 46	20 39	
48	14 20	13	17 45	32 18	13 0	19 18	19 14	+104	19 40	19 30	
49	15 10	19	17 40	33 9	13 0	20 9	20 53	+104	21 19	21 7	
50	14 26	8	17 42	32 16	13 2	19 14	20 23	+102	20 49	20 48	
51	23 53	13	17 52	41 58	19 32	22 26	21 12	—100	20 47	20 34	
52	25 20	21	17 43	43 24	19 45	23 39	21 38	— 87	21 16	21 7	
53	23 48	16	17 38	41 42	19 45	21 57	20 42	— 87	20 20	19 40	
57	26 56	14	17 43	44 53	25 23	19 30	20 9	+138	20 44	20 7	
58	27 24	21	17 57	45 42	25 23	20 19	20 12	+138	20 47	20 16	
59	27 45	2	17 50	45 37	25 29	20 8	19 34	+135	20 8	19 35	
60	28 19	+ 5	17 49	46 13	—25 29	20 44	19 28	+135	20 2	19 6	
Mean										221° 20' 4.4	
Star 19.											
31	332 17 4	—23	18 8	34 49	— 9 56	24 53	26 45	+185	27 31	27 22	
32	17 13	8	18 21	35 26	9 56	25 30	27 32	+185	28 18	27 53	
33	15 20	34	22 10	36 56	9 47	27 9	26 32	+200	27 22	27 6	
34	15 52	25	19 32	34 59	9 47	25 12	26 26	+200	27 16	27 27	
37	9 31	15	20 12	29 28	— 3 15	26 13	27 28	+177	28 12	28 24	
40	6 18	12	21 46	27 52	+ 2	27 54	28 9	—163	27 28	27 1	
41	8 16	17	20 2	28 1	2	28 3	28 11	—163	27 30	27 44	
42	8 28	3	19 59	28 24	6	28 30	27 44	—167	27 2	26 56	
43	3 13	19	19 52	22 46	3 47	26 33	26 43	+183	27 29	27 13	
44	1 6	12	21 30	22 24	3 47	26 11	26 26	+183	27 12	27 0	
45	3 52	17	19 40	23 15	3 48	27 3	26 20	+184	27 6	26 51	
46	331 57 22	9	21 30	18 43	3 48	22 31	26 4	+184	26 50	26 32	
47	332 3 12	9	18 42	21 45	6 58	28 43	27 41	—169	26 59	26 52	
48	4 15	12	17 45	21 48	7 1	28 49	28 45	—172	28 2	27 52	
49	4 10	15	17 40	21 35	7 1	28 36	29 20	—172	28 37	28 25	
50	2 48	9	17 42	20 21	7 3	27 24	28 33	—173	27 50	27 49	
51	331 59 51	10	17 52	17 33	10 33	28 6	26 52	+181	27 37	27 24	
52	332 0 36	22	17 43	17 57	10 40	28 37	26 36	+184	27 22	27 13	
57	331 57 13	13	17 43	14 43	10 22	25 5	25 44	—140	25 9	24 32	
58	57 13	17	17 57	14 53	10 22	25 15	25 8	—140	24 33	24 2	
59	57 29	4	17 50	15 15	10 25	25 40	25 6	—145	24 30	23 57	
60	57 36	— 7	17 49	15 18	+10 25	25 43	24 27	—145	23 51	22 55	
Mean										332° 26' 45.0	

TABLE XX.—Continued.

Star 20.										
Plate No.	Measured Distance.	Re-fract'n.	Aberra-tion.	Division Error.	Cor-rected s.	Proper Motion.	Cor-rected for p. m.	Parallax Coeffi-cient.	Corr. for Paral-lax.	Final Corrected Distance in Arc.
31	48.5459	.0135	+ .0035	.0111	.5732	— .0200	.5532	— .706	.5469	1360.19
32	.5519	141	+ 35	106	.5793	200	.5593	— .707	.5530	60.27
33	.5538	135	+ 35	106	.5806	197	.5609	— .765	.5541	60.34
34	.5480	137	+ 35	106	.5750	197	.5553	— .765	.5465	60.14
36	.5365	134	+ 33	106	.5630	64	.5566	— .569	.5515	60.39
37	.5415	137	+ 33	106	.5683	64	.5619	— .570	.5568	60.28
38	.5460	138	+ 35	106	.5731	— .0057	.5674	— .704	.5611	60.61
40	.5061	152	— 31	106	.5280	+ .0001	.5281	+ .470	.5323	60.04
41	.5078	169	— 31	106	.5314	1	.5315	+ .470	.5358	59.93
42	.5274	143	— 32	108	.5485	2	.5487	+ .508	.5532	60.48
43	.5200	138	+ 34	108	.5472	75	.5547	— .673	.5487	60.19
45	.5230	139	+ 34	108	.5503	75	.5578	— .783	.5508	60.34
46	.5294	142	+ 34	108	.5570	75	.5645	— .682	.5584	60.50
47	.4986	147	— 32	106	.5199	136	.5335	+ .531	.5382	60.11
48	.4915	151	— 33	107	.5132	137	.5269	+ .567	.5319	59.83
49	.5100	160	— 33	108	.5327	137	.5464	+ .567	.5514	60.38
50	.5064	148	— 33	108	.5279	138	.5417	+ .579	.5468	60.23
51	.5132	141	+ 34	108	.5407	205	.5612	— .630	.5556	60.45
52	.5118	138	+ 34	108	.5390	208	.5598	— .690	.5537	60.27
53	.4988	142	+ 34	108	.5264	208	.5472	— .690	.5411	60.11
57	.5006	146	— 26	106	.5234	260	.5494	+ .272	.5518	60.50
58	.5026	158	— 26	106	.5256	260	.5516	+ .272	.5540	60.57
59	.5149	147	— 27	106	.5367	261	.5628	+ .314	.5656	60.81
60	.5088	.0146	— .0027	.0106	.5305	+ .0261	.5566	+ .314	.5594	1360.66
Mean										1360.318
Star 21.										
31	79.3586	.0215	+ .0057	.0125	.3951	— .0496	.3455	— .585	.3403	2222.96
32	.3679	223	+ 57	124	.4051	496	.3555	— .585	.3503	3.09
33	.3652	221	+ 57	124	.4022	488	.3534	— .652	.3486	3.11
34	.3637	218	+ 57	124	.4004	488	.3516	— .652	.3458	3.05
36	.3354	214	+ 53	124	.3713	162	.3551	— .537	.3503	3.36
37	.3352	216	+ 53	124	.3713	162	.3551	— .538	.3503	2.93
38	.3365	223	+ 57	124	.3737	— .0143	.3594	— .583	.3542	3.38
40	.2994	243	— 51	124	.3278	+ .0002	.3280	+ .340	.3310	2.97
41	.2880	257	— 51	124	.3178	2	.3180	+ .340	.3210	2.51
42	.3092	239	— 52	124	.3371	5	.3376	+ .379	.3410	3.17
43	.3006	219	+ 56	124	.3373	189	.3562	— .549	.3513	3.19
44	.3060	223	+ 56	125	.3432	189	.3621	— .549	.3572	3.33
45	.2967	220	+ 56	124	.3335	190	.3525	— .559	.3475	3.24
46	.2861	224	+ 56	124	.3233	190	.3423	— .559	.3373	2.86
47	.2647	242	— 53	124	.2928	348	.3276	+ .403	.3312	2.97
48	.2586	241	— 54	126	.2867	351	.3218	+ .441	.3257	2.66
49	.2632	247	— 54	124	.2917	351	.3268	+ .441	.3307	2.80
50	.2660	243	— 54	124	.2941	352	.3293	+ .454	.3333	2.83
51	.2597	221	+ 55	124	.2965	527	.3492	— .501	.3448	3.11
52	.2670	220	+ 56	124	.3038	532	.3570	— .567	.3520	3.10
53	.2674	225	+ 56	124	.3047	532	.3579	— .567	.3529	3.44
56	.2594	218	+ 57	124	.2951	534	.3485	— .588	.3433	3.29
57	.2345	232	— 42	124	.2627	671	.3298	+ .140	.3310	2.99
58	.2434	242	— 42	124	.2726	671	.3397	+ .140	.3409	3.27
60	.2473	.0241	— .0045	.0124	.2761	+ .0674	.3435	+ .182	.3451	2223.30
Mean										2223.076

TABLE XXI.—*Continued.*

Star 20.		Re-	Zero,	Corr.	Proper	ϕ .	Corr.	Parallax	Corr.	Final
Plate	$270^\circ + \phi'$.	fract'n.	etc.	ϕ .	Motion.		for	Coeffi-	for	corrected
No.							Orient.	cient.	Paral-	Angle.
31	198° 34' 4"	+ 8"	18' 8"	52' 20"	+ 13' 36"	5' 56"	7' 48"	—108	7 21	7 12
32	33 50	+ 9	18 21	52 20	13 36	5 56	7 58	—108	7 31	7 6
33	33 48	+ 5	22 11	56 4	13 24	9 28	8 51	—100	8 26	8 10
34	33 12	+ 8	19 32	52 52	13 24	6 16	7 26	—100	7 1	7 12
36	44 15	+ 8	19 55	4 18	4 28	8 46	8 6	—121	7 36	6 33
37	42 22	+ 9	20 12	2 43	4 28	7 11	8 26	—121	7 56	8 8
38	44 34	+ 7	19 35	4 16	+ 3 37	7 53	8 24	—109	7 57	7 16
40	45 24	+ 6	21 46	7 16	— 3	7 13	7 28	+ 121	7 58	7 31
41	45 46	+ 20	20 2	6 8	3	6 5	6 13	+ 121	6 43	6 57
42	48 32	— 2	19 59	8 29	8	8 21	7 35	+ 119	8 15	8 9
43	53 24	+ 8	19 52	13 24	5 13	8 11	8 21	—112	7 53	7 37
45	53 56	+ 9	19 40	13 45	5 15	8 30	7 47	—111	7 19	7 4
46	48 34	+ 9	21 30	10 13	5 15	4 58	8 31	—111	8 3	7 45
47	58 44	+ 1	18 42	17 27	9 37	7 50	6 48	+ 118	7 17	7 10
48	59 27	+ 7	17 45	17 19	9 41	7 38	7 34	+ 116	8 3	7 53
49	57 54	+ 13	17 40	15 47	9 41	6 6	6 50	+ 116	7 19	7 7
50	57 56	+ 2	17 42	15 40	9 43	5 57	7 6	+ 115	7 35	7 34
51	199 6 46	+ 9	17 52	24 47	14 34	10 13	8 59	—116	8 30	8 17
52	7 12	+ 9	17 43	25 4	14 44	10 20	8 19	—111	7 51	7 42
53	6 26	+ 10	17 38	24 14	14 44	9 30	8 15	—111	7 47	7 7
57	7 40	+ 7	17 43	25 30	18 56	6 34	7 13	+ 124	7 44	7 7
58	8 18	+ 15	17 57	26 30	18 56	7 34	7 24	+ 124	7 55	7 24
59	8 24	— 2	17 50	26 12	19 1	7 11	7 45	+ 124	8 16	7 43
60	10 32	— 0	17 49	28 21	—19 1	9 20	8 4	+ 124	8 35	7 39
Mean										199° 7' 28.5
Star 21.										
31	189 36 12	+ 0	18 8	54 20	+ 8 7	2 27	4 19	— 76	4 0	3 51
32	36 20	+ 6	18 21	54 47	8 7	2 54	4 56	— 76	4 37	4 12
33	35 8	— 6	22 11	57 13	8 0	5 13	4 36	— 71	4 18	4 2
34	34 38	— 0	19 32	54 10	8 0	2 10	3 20	— 71	3 2	3 13
36	43 10	— 0	19 55	3 5	2 40	5 45	5 5	— 81	4 45	4 2
37	39 50	+ 4	20 12	0 6	2 40	2 46	4 1	— 81	3 41	3 53
38	43 34	— 2	19 35	3 7	+ 2 10	5 17	5 48	— 76	5 29	4 48
40	41 32	+ 2	21 46	3 20	— 2	3 18	3 33	+ 80	3 53	3 26
41	42 15	+ 14	20 2	2 31	2	2 29	2 37	+ 80	2 57	3 11
42	45 6	— 3	19 59	5 2	5	4 57	4 11	+ 79	4 31	4 25
43	47 38	+ 3	19 52	7 33	3 7	4 26	4 36	— 77	4 17	4 1
44	46 0	+ 5	21 30	7 35	3 7	4 28	4 43	— 77	4 24	4 12
45	49 33	+ 3	19 40	9 16	3 8	6 8	5 25	— 77	5 6	4 51
46	42 32	+ 6	21 30	4 8	3 8	1 0	4 33	— 77	4 14	3 56
47	51 59	— 1	18 42	10 40	5 45	4 55	3 53	+ 79	4 13	4 6
48	51 44	+ 2	17 45	9 31	5 47	3 44	3 40	+ 78	4 0	3 50
49	51 10	+ 8	17 40	8 58	5 47	3 11	3 55	+ 78	4 15	4 3
50	50 54	— 1	17 42	8 35	5 48	2 47	3 56	+ 78	4 16	4 15
51	56 28	+ 6	17 52	14 26	8 42	5 44	4 30	— 79	4 10	3 57
52	57 40	+ 2	17 43	15 25	8 48	6 37	4 36	— 77	4 17	4 8
53	57 20	+ 5	17 38	15 3	8 48	6 15	5 0	— 77	4 41	4 1
56	56 33	+ 3	17 32	14 8	8 50	5 18	4 45	— 76	4 26	3 49
57	56 52	+ 3	17 43	14 38	1 19	3 19	3 58	+ 79	4 18	3 41
58	57 29	+ 10	17 57	15 36	11 19	4 17	4 10	+ 79	4 30	3 59
60	59 28	— 2	17 49	17 15	—11 22	5 53	4 37	+ 79	4 57	4 1
Mean										190° 3' 59.7

TABLE XX.—Continued.

Star 22.		Re-	Aberra-	Division	Cor-	Proper	Cor-	Parallax	Corr.	Final
Plate	Measured	fract'n.	tion.	Error.	rected	Motion.	rected	Coeffi-	for	Corrected
No.	Distance.				s.		for	cient.	Paral-	Distance
							p. m.		lax.	in Ar.
31	31.8130	.0111	+.0023	.0122	.8382	+.1477	.9859	+.003	.9859	896.18
32	.8368	92	+	23	121	.8600	.1477	+.005	.0077	.73
33	.8361	131	+	23	121	.8632	.1455	+.085	.0094	.81
34	.8368	114	+	23	121	.8622	+.1455	+.085	.0084	.79
41	.9828	105	—	20	117	.0026	— .0006	+.220	.0040	.72
42	.9834	103	—	21	122	.0034	14	+.186	.0036	.76
46	32.0406	93	+	22	122	.0639	570	— .025	.0067	.76
47	.0860	108	—	21	116	.1059	.1046	+.164	.0027	.76
48	.0968	108	—	22	117	.1167	.1054	+.128	.0124	.97
49	.0766	106	—	22	112	.0958	.1054	+.128	.9915	.38
50	.0918	109	—	22	112	.1113	.1057	+.116	.0066	.79
51	.1464	94	+	22	120	.1696	.1586	— .087	.0102	.87
52	.1472	112	+	23	121	.1724	.1603	— .017	.0120	.84
57	.1786	104	—	17	117	.1986	.2025	+.377	.9995	.55
58	.1775	102	—	17	120	.1976	.2025	+.377	.9985	.66
59	.1774	106	—	18	117	.1975	.2033	+.346	.9973	.56
60	.1712	.0108	— .0018	.0117	.1915	— .2033	.9882	+.346	.9913	896.42
Mean										896.679
Star 23.										
31	68.6166	.0196	+.0049	.0122	.6512	+.0944	.7456	+.362	.7488	1926.20
32	.6053	186	+	49	122	.6389	944	+.363	.7365	5.73
33	.6050	213	+	49	121	.6412	930	+.439	.7381	5.84
34	.6051	200	+	49	121	.6400	+.0930	+.439	.7369	5.81
40	.6898	213	—	44	124	.7170	— .0004	— .014	.7165	5.53
41	.7100	208	—	44	124	.7367	4	— .114	.7353	5.91
42	.7059	212	—	45	129	.7334	9	— .153	.7311	5.88
43	.7406	193	+	48	129	.7755	362	+.321	.7421	5.95
46	.7422	188	+	48	129	.7766	364	— .334	.7432	6.04
48	.7854	210	—	47	128	.8124	675	— .216	.7430	6.14
50	.7791	208	—	47	121	.8052	676	— .230	.7356	5.90
57	.8312	202	—	37	124	.8580	.1295	+.076	.7292	5.91
58	.8300	199	—	37	124	.8565	.1295	+.076	.7279	5.88
59	.8324	218	—	38	124	.8607	.1301	+.038	.7310	5.84
60	.8181	.0216	— .0038	.0124	.8462	— .1301	.7161	+.038	.7164	1925.47
Mean										1925.869
Star 24.										
31	34.0871	.0101	+.0024	.0108	.1100	— .1101	.9999	— .269	.9975	952.54
33	.0876	114	+	24	114	.1124	.1085	— .270	.0015	.62
34	.0966	104	+	24	114	.1204	.1085	— .348	.9988	.55
37	.0256	95	+	23	114	.0488	361	— .111	.0117	.81
38	.0202	109	+	24	114	.0445	— .0319	— .267	.0102	.91
43	33.9462	97	+	24	110	.9689	+.0420	— .228	.0089	.83
44	.9346	95	+	24	108	.9569	420	— .228	.9969	.48
45	.9322	96	+	24	110	.9548	423	— .240	.0050	.79
46	.9413	94	+	24	110	.9637	423	— .240	.0039	.72
47	.8992	108	—	23	110	.9183	773	+.087	.9964	.63
48	.8964	105	—	23	111	.9153	779	+.126	.9943	.50
49	.8890	104	—	23	111	.9088	779	+.126	.9978	.32
50	.8942	108	—	23	111	.9134	781	+.139	.9927	.44
51	.8676	93	+	24	111	.8901	1171	— .178	.0056	.78
53	.8624	91	+	24	111	.8849	1184	— .249	.9993	.65
57	.8311	101	—	18	114	.8504	1492	— .160	.9982	.67
58	.8291	99	—	18	111	.8479	1492	— .160	.9957	.62
59	.8389	108	—	19	114	.8588	1494	— .123	.0075	.89
60	.8348	.0107	— .0019	.0114	.8546	— .1498	.0044	— .123	.0033	952.79
Mean										952.660

TABLE XXI.—*Continued.*

Star 22.		Re-	Zero.	Corr.	Proper		Corr.	Parallax	Corr.	Final
Plate	270° + p'.	fract'n	etc.	p.	Motion.	p.	for	Coef-	for	corrected
No.							Orient.	ficient.	Paral-	Angle.
31	334° 28' 29"	—22"	18 8"	46 15"	—13 1"	33 14"	35 6"	+230	36 4	35 55
32	27 30	8	18 21	45 43	13 1	32 42	34 44	+230	35 42	35 17
33	26 4	34	22 11	47 41	12 49	34 52	34 15	+231	35 13	34 57
34	26 4	23	19 32	45 13	—12 49	32 24	33 34	+230	34 32	34 43
41	16 22	15	20 2	36 9	+	36 12	36 20	—205	35 29	35 43
42	16 29	3	19 59	36 25	7	36 32	35 46	—211	34 53	34 47
46	5 37	9	21 30	26 58	4 59	31 57	35 30	+229	36 27	36 9
47	10 14	9	18 42	28 47	9 7	37 54	36 52	—212	35 59	35 52
48	10 50	12	17 45	28 23	9 12	37 35	37 31	—216	36 37	36 27
49	8 58	14	17 40	26 24	9 12	35 36	34 52	—216	33 58	33 46
50	8 39	9	17 42	26 12	9 14	35 26	36 35	—217	35 41	35 40
51	2 10	9	17 52	19 53	13 48	33 41	32 27	+226	33 23	33 10
52	5 1	22	17 43	22 22	13 57	36 19	34 18	+230	35 16	35 7
57	0 2	12	17 43	17 33	17 55	35 28	36 7	—177	35 23	34 46
58	0 42	14	17 57	18 25	17 55	36 20	36 13	—177	35 29	34 58
59	1 34	4	17 50	19 20	18 0	37 20	36 46	—183	36 0	35 27
60	0 36	—7	17 49	18 18	+18 0	36 18	35 2	—183	34 16	33 20
Mean									334° 35' 3.8	
Star 23.										
31	355 18 42	—11	18 8	36 39	—8 14	28 25	30 17	+100	30 42	30 33
32	18 21	—0	18 21	36 42	8 14	28 28	30 30	+100	30 55	30 30
33	16 43	—21	22 11	38 33	8 6	30 27	29 50	+98	30 14	29 58
34	18 6	—12	19 32	37 26	—8 6	29 20	30 30	+98	30 54	31 5
40	10 3	—5	21 46	31 44	+	31 46	32 1	—99	31 36	31 9
41	10 34	+2	20 2	30 38		30 40	30 48	—99	30 23	30 37
42	11 20	—4	19 59	31 15	5	31 20	30 34	—99	30 9	30 3
43	6 34	—8	19 52	26 18	3 9	29 27	29 37	+102	30 3	29 47
46	2 7	—0	21 30	23 37	3 10	26 47	30 20	+102	30 46	30 28
48	7 32	—4	17 45	25 13	5 50	31 3	30 59	—99	30 34	30 24
50	5 28	—5	17 42	23 5	5 52	28 57	30 6	—99	29 41	29 40
57	1 45	—4	17 43	19 24	11 25	30 49	31 28	—92	31 5	30 28
58	1 38	—0	17 57	19 35	11 25	31 0	30 53	—92	30 30	29 59
59	2 35	—4	17 50	20 21	11 28	31 49	31 15	—93	30 52	30 19
60	2 45	—4	17 49	20 30	+11 28	31 58	30 42	—93	30 19	29 23
Mean									355° 30' 17.5	
Star 24.										
31	169 24 2	—16	18 8	41 54	+15 56	57 50	59 42	—209	58 50	58 41
33	23 29	26	22 11	45 14	15 42	0 56	0 19	—205	59 28	59 12
34	21 38	17	19 32	40 53	15 42	56 35	57 45	—205	56 54	57 5
37	32 24	8	20 12	52 28	5 15	57 43	58 58	—210	58 6	58 18
38	37 16	14	19 35	56 37	+4 15	0 52	1 23	—210	0 31	59 50
43	46 16	11	19 52	5 57	—6 8	59 49	59 59	—211	59 6	58 50
44	46 26	5	21 30	7 51	6 8	1 43	1 58	—211	1 5	60 53
45	47 34	9	19 40	7 5	6 10	0 55	0 12	—210	59 20	59 5
46	42 26	3	21 30	3 53	6 10	57 43	1 16	—210	0 24	60 6
47	53 57	6	18 42	12 33	11 19	1 14	0 12	+203	1 3	60 56
48	52 44	6	17 45	10 23	11 25	58 58	58 54	+204	59 45	59 35
49	51 16	5	17 40	8 51	11 25	57 26	58 10	+204	59 1	58 49
50	50 8	7	17 42	7 43	11 27	56 16	57 25	+204	58 16	58 15
51	170 0 15	3	17 52	18 4	17 11	0 53	59 39	—211	58 46	58 33
53	0 39	6	17 38	18 11	17 22	0 49	59 34	—210	58 42	58 2
57	3 16	6	17 43	20 53	22 21	58 32	59 11	+183	59 57	59 20
58	3 52	4	17 57	21 45	22 21	59 24	59 17	+183	0 3	59 32
59	4 36	5	17 50	22 21	22 26	59 55	59 21	+187	0 8	59 35
60	5 58	—6	17 49	23 41	—22 26	1 15	59 59	+187	0 46	59 50
Mean									169° 59' 10.9	

TABLE XX.—*Continued.*

Star 25.										Final Corrected Distance in Arc.
Plate No.	Measured Distance.	Re- fract'n.	Aberra- tion.	Division Error.	Cor- rected s.	Proper Motion.	Cor- rected for p. m.	Parallax Coeffi- cient.	Corr. for Paral- lax.	
31	27.1738	.0077	+.0019	.0110	.1940	— .0207	.1733	+.839	.1808	761.55
32	.1789	85	+	19	.110	.1999	207	+.840	.1867	.66
33	.1681	83	+	20	.110	.1890	204	+.885	.1765	.96
34	.1712	85	+	20	.110	.1923	204	+.885	.1798	.50
36	.1632	82	+	18	.109	.1837	67	+.723	.1834	.66
37	.1620	84	+	18	.109	.1827	67	+.724	.1824	.49
38	.1565	84	+	19	.110	.1774	— .0059	+.838	.1789	.51
40	.1718	89	—	17	.109	.1895	+.0001	— .627	.1840	.73
41	.1710	107	—	17	.110	.1906	1	— .627	.1851	.70
42	.1572	80	—	18	.108	.1738	2	— .661	.1681	.26
43	.1380	83	+	19	.108	.1586	75	+.812	.1733	.32
44	.1362	85	+	19	.108	.1570	75	+.812	.1717	.26
45	.1370	84	+	19	.108	.1577	76	+.820	.1726	.35
46	.1418	85	+	19	.112	.1630	76	+.820	.1779	.47
47	.1476	84	—	18	.113	.1651	137	— .683	.1727	.42
48	.1488	89	—	18	.113	.1568	140	— .714	.1644	.13
49	.1486	98	—	18	.114	.1676	140	— .714	.1752	.43
50	.1435	85	—	19	.114	.1621	141	— .726	.1697	.26
51	.1278	84	+	19	.110	.1469	207	+.776	.1775	.47
52	.1324	83	+	19	.110	.1532	209	+.827	.1815	.51
53	.1398	86	+	19	.114	.1613	209	+.827	.1896	.84
54	.1294	78	+	19	.109	.1496	210	+.842	.1781	.48
55	.1303	82	+	19	.111	.1511	210	+.842	.1796	.58
56	.1170	84	+	19	.114	.1383	210	+.842	.1668	.25
57	.1228	87	—	14	.110	.1407	260	— .437	.1628	.15
58	.1167	97	—	14	.109	.1355	260	— .437	.1576	.00
59	.1218	82	—	15	.109	.1390	260	— .478	.1608	.04
60	.1249	.0083	— .0015	.0109	.1422	.0260	.1682	— .478	.1640	761.15
Mean										761.433
Star 26.										
31	97.4508	.0291	+.0069	.0138	.4949	— .1124	.3825	— .254	.3803	2728.40
32	.4538	268	+	69	.139	.4957	1124	— .256	.3811	8.24
33	.4383	328	+	70	.139	.4863	1107	— .334	.3726	8.09
34	.4390	298	+	70	.139	.4840	1107	— .334	.3703	8.04
36	.3702	296	+	66	.139	.4146	369	— .095	.3769	8.45
37	.3660	275	+	66	.139	.4083	369	— .096	.3706	7.75
38	.3668	318	+	69	.139	.4137	— .0326	— .252	.3789	8.41
40	.3252	306	—	62	.138	.3577	+.0004	+.010	.3582	8.11
41	.3330	297	—	62	.138	.3646	4	+.010	.3651	8.09
42	.3383	304	—	64	.138	.3704	11	+.048	.3719	8.41
43	.2892	280	+	69	.138	.3322	430	— .214	.3733	8.12
44	.2898	274	+	69	.138	.3322	430	— .214	.3733	8.09
45	.2818	279	+	69	.138	.3247	433	— .226	.3660	8.10
46	.2930	209	+	69	.138	.3349	433	— .226	.3762	8.28
47	.2524	310	—	65	.138	.2850	792	+.072	.3648	8.30
48	.2492	303	—	66	.138	.2810	799	+.111	.3619	8.02
49	.2494	297	—	66	.137	.2805	799	+.111	.3614	8.01
50	.2490	311	—	67	.138	.2815	801	+.125	.3627	8.00
51	.2112	267	+	67	.138	.2527	1202	— .163	.3715	8.19
53	.2090	278	+	69	.138	.2518	1204	— .234	.3701	8.28
54	.2070	366	+	69	.138	.2586	1218	— .258	.3781	8.34
55	.2040	302	+	69	.138	.2492	1218	— .258	.3687	8.30
56	.2072	280	+	69	.138	.2502	1218	— .258	.3697	8.42
57	.1803	291	—	52	.139	.2124	1532	— .172	.3641	8.31
58	.1848	285	—	52	.139	.2163	1532	— .172	.3680	8.42
59	.1900	312	—	55	.139	.2239	1539	— .136	.3766	8.49
60	.1808	.0310	— .0055	.0139	.2145	+.1539	.3681	— .136	.3672	2728.29
Mean										2728.220

TABLE XXI.—Continued.

Star 25.		Re-	Zero,	Corr.	Proper	δ .	Corr.	Parallax	Corr.	Final
Plate	$270^\circ + \delta$.	fract'n.	etc.	δ .	Motion.		for	Coeffi-	for	corrected
No.							Orient.	cient.	Paral-	Angle.
31	$31^\circ 17' 3''$	$+17''$	$18' 8''$	$35' 28''$	$-23' 58''$	$11' 30''$	$13' 22''$	$+149$	$13' 59$	$13' 50$
32	$16' 10''$	11	$18' 21''$	$34' 42''$	$23' 58''$	$10' 44''$	$12' 46''$	$+149$	$13' 23$	$12' 58$
33	$13' 24''$	19	$22' 11''$	$35' 54''$	$23' 37''$	$12' 17''$	$11' 40''$	$+131$	$12' 13$	$11' 57$
34	$15' 40''$	18	$19' 32''$	$35' 30''$	$23' 37''$	$11' 53''$	$13' 3''$	$+131$	$13' 36$	$13' 47$
36	$0' 55''$	18	$19' 55''$	$21' 8''$	$7' 53''$	$13' 15''$	$12' 35''$	$+178$	$13' 19$	$12' 36$
37	$30' 57' 48''$	14	$20' 12''$	$18' 14''$	$7' 53''$	$10' 21''$	$11' 36''$	$+178$	$12' 20$	$12' 32$
38	$31' 0' 1''$	18	$19' 35''$	$19' 54''$	$-6' 22''$	$13' 32''$	$14' 3''$	$+150$	$14' 41$	$14' 0$
40	$30' 51' 8''$	10	$21' 46''$	$13' 4''$	$+5''$	$13' 9''$	$13' 24''$	-184	$12' 38$	$12' 11$
41	$53' 42''$	$+24''$	$20' 2''$	$14' 8''$	5	$14' 13''$	$14' 21''$	-184	$13' 35$	$13' 49$
42	$53' 23''$	$-1''$	$19' 59''$	$13' 21''$	13	$13' 34''$	$12' 48''$	-179	$12' 3$	$11' 57$
43	$42' 57''$	$+16''$	$19' 52''$	$3' 5''$	$9' 12''$	$12' 17''$	$12' 27''$	$+158$	$13' 7$	$12' 51$
44	$40' 9''$	13	$21' 30''$	$1' 52''$	$9' 12''$	$11' 4''$	$11' 19''$	$+158$	$11' 59$	$11' 47$
45	$44' 37''$	15	$19' 40''$	$4' 32''$	$9' 15''$	$13' 47''$	$13' 4''$	$+155$	$13' 43$	$13' 28$
46	$37' 19''$	12	$21' 30''$	$59' 1''$	$9' 15''$	$8' 16''$	$11' 49''$	$+155$	$12' 28$	$12' 10$
47	$38' 5''$	5	$18' 42''$	$56' 52''$	$16' 57''$	$13' 59''$	$12' 57''$	-176	$12' 13$	$12' 6$
48	$38' 28''$	11	$17' 45''$	$56' 24''$	$17' 5''$	$13' 29''$	$13' 25''$	-170	$12' 43$	$12' 33$
49	$36' 34''$	18	$17' 40''$	$54' 32''$	$17' 5''$	$11' 37''$	$12' 21''$	-170	$11' 39$	$11' 27$
50	$36' 56''$	5	$17' 42''$	$54' 43''$	$17' 8''$	$11' 51''$	$13' 0''$	-167	$12' 18$	$12' 17$
51	$29' 21''$	12	$17' 52''$	$47' 25''$	$25' 42''$	$13' 7''$	$11' 53''$	$+167$	$12' 35$	$12' 22$
52	$30' 16''$	16	$17' 43''$	$48' 15''$	$25' 59''$	$14' 14''$	$12' 13''$	$+154$	$12' 51$	$12' 42$
53	$29' 37''$	14	$17' 38''$	$47' 29''$	$25' 59''$	$13' 28''$	$12' 13''$	$+154$	$12' 51$	$12' 11$
54	$30' 53''$	17	$17' 20''$	$48' 30''$	$26' 4''$	$14' 34''$	$12' 18''$	$+148$	$12' 45$	$12' 10$
55	$32' 18''$	18	$17' 27''$	$50' 3''$	$26' 4''$	$16' 7''$	$13' 37''$	$+148$	$14' 4$	$13' 51$
56	$27' 36''$	15	$17' 32''$	$45' 23''$	$26' 4''$	$11' 27''$	$10' 54''$	$+149$	$11' 21$	$10' 44$
57	$21' 34''$	10	$17' 43''$	$39' 27''$	$33' 25''$	$12' 52''$	$13' 31''$	-201	$12' 41$	$12' 4$
58	$21' 59''$	19	$17' 57''$	$40' 15''$	$33' 25''$	$13' 40''$	$13' 33''$	-201	$12' 43$	$12' 12$
59	$23' 46''$	0	$17' 50''$	$41' 36''$	$33' 33''$	$15' 9''$	$14' 35''$	-198	$14' 11$	$13' 38$
60	$24' 12''$	$+2''$	$17' 49''$	$42' 3''$	$+33' 33''$	$15' 36''$	$14' 20''$	-108	$13' 56$	$13' 0$
Mean										$31^\circ 12' 36.8$

Star 26.

31	168	43 13	-15	18 8	1 6	+5 35	6 41	8 33	-74	8 14	8 5
32		42 17	2	18 21	0 36	5 35	6 11	8 13	-73	7 55	7 30
33		41 33	26	22 11	3 18	5 30	8 48	8 11	-72	7 53	7 37
34		41 11	17	19 32	0 26	5 30	5 56	7 6	-72	6 48	6 59
36		47 14	18	19 55	6 51	1 50	8 41	8 1	-74	7 42	6 59
37		44 58	8	20 12	5 2	1 50	6 52	8 7	-74	7 49	8 1
38		47 11	21	19 35	6 25	+1 29	7 54	8 25	-74	8 7	7 26
40		45 25	7	21 46	7 4	-1	7 3	7 18	+70	7 36	7 9
41		46 16	4	20 2	6 14	1	6 13	6 21	+70	6 39	6 53
42		48 25	4	19 59	8 20	3	8 17	7 31	+71	7 49	7 43
43		50 30	12	19 52	10 10	2 9	8 1	8 11	-74	7 53	7 37
44		49 18	5	21 30	10 43	2 9	8 34	8 49	-74	8 31	8 19
45		51 45	9	19 40	11 16	2 9	9 7	8 24	-74	8 6	7 51
46		45 26	3	21 30	6 53	2 9	4 44	8 17	-74	7 59	7 41
47		53 57	7	18 42	12 32	3 57	8 35	7 33	+71	7 51	7 44
48		53 41	7	17 45	11 19	3 59	7 20	7 16	+73	7 34	7 24
49		53 16	5	17 40	10 51	3 59	6 52	7 36	+72	7 54	7 42
50		52 36	7	17 42	10 11	4 0	6 11	7 20	+72	7 38	7 37
51		57 28	4	17 52	15 16	6 0	9 16	8 2	-74	7 54	7 41
53		57 34	7	17 38	15 5	6 4	9 1	7 46	-74	7 28	6 48
54	169	0 17	38	17 20	16 59	6 5	10 54	8 38	-74	8 20	7 45
55	168	59 32	19	17 27	16 40	6 5	10 35	7 55	-74	7 37	7 24
56		57 41	10	17 32	15 3	6 5	8 58	8 25	-74	8 7	7 30
57		57 29	7	17 43	15 5	7 47	7 18	7 57	+64	8 13	7 36
58		57 59	4	17 57	15 52	7 47	8 5	7 58	+64	8 14	7 43
59		58 49	5	17 50	16 34	7 49	8 45	8 11	-66	8 27	7 54
60		59 28	-6	17 49	17 11	-7 49	9 22	8 6	+66	8 22	7 16
Mean										169° 7' 33.1	

TABLE XX.—*Continued.*

Star 27.		Re- fract'n.	Aberra- tion.	Division Error.	Cor- rected s.	Proper Motion.	Cor- rected for p. m.	Parallax Coeffi- cient.	Corr. for Paral- lax.	Final Corrected Distance in Arc.
Plate No.	Measured Distance.									
31	62.1906	.0264	+.0044	.0110	.2310	-.1794	.0516	+.327	.0545	1738.64
32	.2094	198	+ 44	111	.2433	.1794	.0639	+.325	.0668	8.87
33	.1776	322	+ 45	111	.2240	-.1767	.0473	+.249	.0495	8.44
44	.9490	211	+ 44	110	.9811	+.0688	.0529	+.363	.0561	8.61
48	.8729	232	— 42	110	.9015	.1278	.0293	— .430	.0255	7.92
50	.8805	229	— 42	110	.9088	.1281	.0369	— .419	.0332	8.10
51	.8211	203	+ 43	110	.8553	.1922	.0475	— .416	.0438	8.37
57	.7673	226	— 33	112	.7964	.2451	.0415	— .610	.0361	8.36
58	.7641	230	— 33	107	.7931	.2451	.0382	— .610	.0328	8.27
59	.7749	212	— 35	110	.8022	.2461	.0483	— .591	.0431	8.45
60	.7724	.0221	— .0035	.0110	.8006	+.2461	.0467	— .591	.0415	1738.44
Mean										1738.406
Star 28.										
31	54.7527	.0255	+.0039	.0110	.7920	-.1893	.6027	+.515	.6073	1529.99
32	.7516	189	+ 39	106	.7839	.1893	.5946	+.514	.5992	29.66
33	.7346	312	+ 39	106	.7792	.1865	.5927	+.445	.5967	29.63
34	.7483	264	+ 39	112	.7887	.1865	.6022	+.445	.6062	29.91
36	.6312	265	+ 37	106	.6709	.623	.6086	+.628	.6142	30.26
37	.6350	216	+ 37	109	.6701	.623	.6078	+.628	.6134	29.94
38	.6218	290	+ 39	109	.6645	-.0550	.6095	+.517	.6141	30.20
40	.5737	220	— 35	106	.6017	+.0007	.6024	— .652	.5966	29.87
41	.5638	242	— 35	112	.5946	.7	.5953	— .652	.5835	29.55
42	.5707	235	— 36	109	.6004	.18	.6022	— .633	.5966	29.82
43	.4925	237	+ 39	109	.5299	.726	.6025	+.547	.6074	29.94
44	.4887	202	+ 39	109	.5226	.726	.5952	+.547	.6001	29.72
45	.4894	225	+ 39	104	.5251	.729	.5981	+.537	.6028	29.92
46	.4952	192	+ 39	104	.5276	.729	.6005	+.537	.6053	29.93
47	.4282	206	— 36	111	.4552	.1338	.5890	— .619	.5835	29.51
48	.4350	219	— 37	109	.4630	.1349	.5979	— .595	.5926	29.62
49	.4322	231	— 37	113	.4618	.1349	.5967	— .595	.5914	29.59
50	.4324	209	— 37	113	.4598	.1352	.5950	— .587	.5898	29.55
51	.3618	193	+ 38	107	.3945	.2028	.5973	+.584	.6025	29.87
52	.3554	251	+ 39	104	.3937	.2050	.5987	+.532	.6034	29.75
53	.3568	213	+ 39	107	.3916	.2050	.5966	+.532	.6013	29.91
54	.3591	361	+ 39	107	.4087	.2057	.6144	+.512	.6189	30.31
55	.3588	275	+ 39	107	.3998	.2057	.6055	+.512	.6100	30.19
56	.3500	228	+ 39	111	.3867	.2057	.5924	+.512	.5969	29.87
57	.3120	213	— 29	112	.3405	.2588	.5993	— .721	.5929	29.79
58	.3005	225	— 29	109	.3299	.2588	.5887	— .721	.5823	29.49
59	.3144	188	— 30	109	.3400	.2598	.5998	— .711	.5935	29.71
60	.3084	.0109	— .0030	.0109	.3351	+.2598	.5949	— .711	.5886	1529.60
Mean										1529.625
Star 29.										
31	99.3042	.0413	+.0071	.0141	.3606	-.1770	.1836	-.292	.1862	2779.00
33	.3076	503	+ 72	134	.3714	-.1744	.1980	-.215	.1999	9.28
41	.1366	384	— 64	138	.1763	+.0007	.1770	— .476	.1728	8.74
46	.0617	321	— 70	141	.1088	.682	.1770	— .320	.1798	8.81
48	.0018	364	— 67	138	.0392	.1261	.1653	— .400	.1617	8.45
50	98.9916	362	— 68	138	.0287	.1264	.1551	— .389	.1516	8.12
58	.8939	362	— 53	138	.9325	.2419	.1744	— .588	.1692	8.90
59	.9012	339	— 56	138	.9372	.2429	.1801	— .568	.1751	8.89
60	.8474	.0352	— .0056	.0138	.9247	+.2429	.1676	— .568	.1626	2778.60
Mean										2778.754

TABLE XXI.—*Continued.*

Star 27.		Re-	Zero,	Corr.	Proper		Corr.	Parallax	Corr.	Final
Plate	$270^{\circ} + \rho'$	fract'n.	etc.	ρ'	Motion	ρ'	for	Coeffi-	for	corrected
No.							Orient.	cient.	Paral-	Angle.
31	$135^{\circ} 9' 41''$	$-23''$	$18' 8''$	$27' 26''$	$+3' 49''$	$31' 15''$	$33' 7''$	-113	$32' 39''$	$32' 30''$
32	$8' 50''$	$2''$	$18' 21''$	$27' 9''$	$3' 49''$	$30' 58''$	$33' 0''$	-113	$32' 32''$	$32' 7''$
33	$6' 42''$	$26''$	$22' 11''$	$28' 27''$	$+3' 46''$	$32' 13''$	$31' 36''$	-107	$31' 11''$	$30' 55''$
44	$13' 38''$	$14''$	$21' 30''$	$34' 54''$	$-1' 28''$	$33' 26''$	$33' 11''$	-111	$32' 43''$	$32' 31''$
48	$16' 6''$	$14''$	$17' 45''$	$33' 37''$	$2' 44''$	$30' 53''$	$30' 49''$	$+100$	$31' 14''$	$31' 4''$
50	$14' 48''$	$8''$	$17' 42''$	$32' 22''$	$2' 45''$	$29' 37''$	$30' 46''$	$+101$	$31' 11''$	$31' 10''$
51	$19' 48''$	$13''$	$17' 52''$	$37' 27''$	$4' 7''$	$33' 20''$	$32' 6''$	-107	$31' 39''$	$31' 2''$
57	$19' 54''$	$14''$	$17' 43''$	$37' 23''$	$5' 21''$	$32' 2''$	$32' 41''$	$+72$	$32' 59''$	$32' 22''$
58	$20' 28''$	$21''$	$17' 57''$	$38' 4''$	$5' 21''$	$32' 43''$	$32' 36''$	$+72$	$32' 54''$	$32' 23''$
59	$20' 56''$	$2''$	$17' 50''$	$38' 44''$	$5' 22''$	$33' 22''$	$32' 48''$	$+76$	$33' 7''$	$32' 34''$
60	$21' 33''$	$-5''$	$17' 49''$	$39' 17''$	$-5' 22''$	$33' 55''$	$32' 39''$	$+76$	$32' 58''$	$32' 2''$
Mean										$135^{\circ} 31' 52.7$
Star 28.										
31	$123' 19' 53''$	$-18''$	$18' 8''$	$37' 43''$	$+1' 55''$	$39' 38''$	$41' 30''$	-116	$41' 1''$	$40' 52''$
32	$19' 6''$	$11''$	$18' 21''$	$37' 16''$	$1' 55''$	$39' 11''$	$41' 13''$	-116	$40' 44''$	$40' 19''$
33	$18' 20''$	$21''$	$22' 11''$	$40' 10''$	$1' 54''$	$42' 4''$	$41' 27''$	-122	$40' 57''$	$40' 41''$
34	$18' 48''$	$19''$	$19' 32''$	$38' 1''$	$1' 54''$	$39' 55''$	$41' 5''$	-122	$40' 35''$	$40' 46''$
36	$21' 38''$	$19''$	$19' 55''$	$41' 14''$	$38''$	$41' 52''$	$41' 12''$	-101	$40' 47''$	$40' 4''$
37	$19' 32''$	$15''$	$20' 12''$	$39' 29''$	$38''$	$40' 7''$	$41' 22''$	-101	$40' 57''$	$40' 45''$
38	$21' 8''$	$20''$	$19' 35''$	$40' 23''$	$+31''$	$40' 54''$	$41' 25''$	-116	$40' 56''$	$40' 15''$
40	$18' 11''$	$11''$	$21' 46''$	$39' 46''$	$0''$	$39' 46''$	$40' 1''$	$+88$	$40' 23''$	$39' 56''$
41	$20' 52''$	$-25''$	$20' 2''$	$40' 29''$	$0''$	$40' 29''$	$40' 37''$	$+88$	$40' 59''$	$41' 13''$
42	$22' 4''$	$+1''$	$19' 59''$	$42' 4''$	$1''$	$42' 3''$	$41' 17''$	$+93$	$41' 30''$	$41' 24''$
43	$22' 10''$	$-17''$	$19' 52''$	$41' 45''$	$44''$	$41' 1''$	$41' 11''$	-113	$40' 43''$	$40' 27''$
44	$21' 26''$	$13''$	$21' 30''$	$42' 43''$	$44''$	$41' 59''$	$42' 14''$	-113	$41' 46''$	$41' 34''$
45	$23' 16''$	$16''$	$19' 40''$	$42' 40''$	$45''$	$41' 55''$	$41' 12''$	-114	$40' 43''$	$40' 28''$
46	$17' 31''$	$12''$	$21' 30''$	$38' 52''$	$45''$	$38' 7''$	$41' 40''$	-114	$41' 11''$	$40' 53''$
47	$24' 38''$	$5''$	$18' 42''$	$43' 15''$	$1' 22''$	$41' 53''$	$40' 51''$	$+96$	$41' 15''$	$41' 8''$
48	$23' 22''$	$11''$	$17' 45''$	$40' 56''$	$1' 23''$	$39' 33''$	$39' 29''$	$+100$	$39' 54''$	$39' 44''$
49	$23' 29''$	$18''$	$17' 40''$	$40' 51''$	$1' 23''$	$39' 28''$	$40' 12''$	$+100$	$40' 37''$	$40' 25''$
50	$22' 48''$	$6''$	$17' 42''$	$40' 24''$	$1' 23''$	$39' 1''$	$40' 10''$	$+101$	$40' 35''$	$40' 34''$
51	$27' 1''$	$12''$	$17' 52''$	$44' 41''$	$2' 4''$	$42' 37''$	$41' 23''$	-108	$40' 56''$	$40' 43''$
52	$28' 4''$	$18''$	$17' 43''$	$45' 29''$	$2' 6''$	$43' 23''$	$41' 22''$	-115	$40' 53''$	$40' 44''$
53	$27' 36''$	$14''$	$17' 38''$	$45' 0''$	$2' 6''$	$42' 54''$	$41' 39''$	-115	$41' 10''$	$40' 30''$
54	$28' 49''$	$21''$	$17' 20''$	$45' 48''$	$2' 6''$	$43' 42''$	$41' 26''$	-116	$40' 57''$	$40' 22''$
55	$28' 11''$	$20''$	$17' 27''$	$45' 18''$	$2' 6''$	$43' 12''$	$40' 32''$	-116	$40' 3''$	$39' 50''$
56	$27' 19''$	$16''$	$17' 32''$	$44' 35''$	$2' 6''$	$42' 29''$	$41' 56''$	-116	$41' 27''$	$40' 50''$
57	$26' 4''$	$12''$	$17' 43''$	$43' 35''$	$2' 42''$	$40' 53''$	$41' 32''$	$+63$	$41' 48''$	$41' 11''$
58	$26' 34''$	$20''$	$17' 57''$	$44' 11''$	$2' 42''$	$41' 29''$	$41' 22''$	$+63$	$41' 38''$	$41' 7''$
59	$26' 48''$	$0''$	$17' 50''$	$44' 38''$	$2' 42''$	$41' 56''$	$41' 22''$	$+67$	$41' 39''$	$41' 6''$
60	$27' 47''$	$-3''$	$17' 49''$	$45' 33''$	$-2' 42''$	$42' 51''$	$41' 35''$	$+67$	$41' 52''$	$40' 56''$
Mean										$123^{\circ} 40' 40.2$
Star 29.										
31	$137' 7' 41''$	$-23''$	$18' 8''$	$25' 26''$	$+2' 39''$	$28' 5''$	$29' 57''$	-71	$29' 39''$	$29' 30''$
33	$6' 1''$	$31''$	$22' 11''$	$27' 41''$	$+2' 36''$	$30' 17''$	$29' 40''$	-73	$29' 22''$	$29' 6''$
41	$9' 19''$	$24''$	$20' 2''$	$28' 57''$	$-1' 1''$	$28' 56''$	$29' 4''$	$+59$	$29' 19''$	$29' 33''$
46	$6' 8''$	$13''$	$21' 30''$	$27' 25''$	$1' 1''$	$26' 24''$	$29' 57''$	-71	$29' 39''$	$29' 21''$
48	$13' 25''$	$14''$	$17' 45''$	$30' 56''$	$1' 53''$	$29' 3''$	$28' 59''$	$+64$	$29' 15''$	$29' 5''$
50	$13' 5''$	$8''$	$17' 42''$	$30' 39''$	$1' 54''$	$28' 45''$	$29' 54''$	$+64$	$30' 10''$	$30' 9''$
58	$15' 42''$	$20''$	$17' 57''$	$33' 19''$	$3' 41''$	$29' 38''$	$29' 31''$	$+47$	$29' 43''$	$29' 12''$
59	$16' 54''$	$3''$	$17' 50''$	$34' 41''$	$3' 42''$	$30' 59''$	$30' 25''$	$+49$	$30' 37''$	$30' 4''$
60	$17' 48''$	$-6''$	$17' 49''$	$35' 31''$	$-3' 42''$	$31' 49''$	$30' 33''$	$+49$	$30' 45''$	$29' 49''$
Mean										$137^{\circ} 29' 32.1$

TABLE XX.—*Continued.*

Star 30.		Re-	Aberra-	Division	Cor-	Proper	Cor-	Parallax	Corr.	Final
Plate	Measured	fract'n.	tion.	Error.	rected	Motion.	rected	Coeffi-	for	Corrected
No.	Distance.				s.		for	cient.	Paral-	Distance
							p. m.		ax.	in Arc.
31	115.4912	.0466	+.0082	.0120	.5487	— .1058	.4429	+1.000	.4518	3234.73
32	.4732	416	+ 82	117	.5254	.1058	.4196	+ .999	.4285	3.86
33	.4612	501	+ 83	117	.5220	.1042	.4178	+1.009	.4268	3.91
34	.4622	481	+ 83	118	.5211	— .1042	.4169	+1.009	.4259	3.91
41	.3592	578	— 74	112	.4115	+ .0004	.4119	— .869	.4042	3.53
58	.2209	.0518	— .0062	.0116	.2688	+ .1442	.4130	— .729	.4053	3233.86
Mean										3233.967
Star 31.										
31	128.5552	.0595	+.0091	.0039	.6085	— .1891	.4194	+ .508	.4239	3598.18
32	.5704	435	+ 91	30	.6128	.1891	.4237	+ .507	.4282	8.06
33	.5406	728	+ 92	38	.6132	.1864	.4268	+ .437	.4307	8.24
34	.5470	616	+ 92	38	.6084	— .1864	.4220	+ .437	.4259	8.13
40	.4112	515	— 82	30	.4447	+ .0007	.4454	— .646	.4397	9.06
43	.3082	555	+ 90	48	.3647	725	.4372	+ .540	.4420	8.57
44	.2930	472	+ 90	48	.3412	725	.4137	+ .540	.4285	8.16
46	.3040	450	+ 91	48	.3501	729	.4230	+ .531	.4277	8.27
49	.2608	541	— 87	52	.2986	.1347	.4333	— .588	.4281	8.48
50	.2651	491	— 88	51	.2977	.1351	.4328	— .581	.4276	8.40
52	.1810	590	+ 91	48	.2411	.2047	.4458	+ .524	.4505	8.63
53	.1735	499	+ 91	46	.2213	.2047	.4260	+ .524	.4307	8.59
57	.1166	501	— 69	46	.1516	.2585	.4101	— .717	.4038	8.09
58	.1218	528	— 69	30	.1579	.2585	.4164	— .717	.4101	8.28
59	.1238	444	— 72	30	.1512	.2596	.4108	— .706	.4045	7.89
60	.1220	.0468	— .0072	.0030	.1518	.2596	.4114	— .706	.4051	3597.99
Mean										3598.314
Star 32.										
31	87.3224	.0431	+.0062	.0121	.3799	— .1682	.2117	+ .932	.2200	2443.73
32	.3232	337	+ 62	127	.3719	.1682	.2037	+ .931	.2120	3.34
33	.2965	501	+ 63	127	.3617	.1658	.1959	+ .901	.2039	3.19
34	.3176	448	+ 63	130	.3778	.1658	.2120	+ .901	.2200	3.66
38	.1844	476	+ 62	126	.2469	— .0489	.1980	+ .932	.2063	3.39
40	.1626	375	— 56	130	.2036	+ .0006	.2042	— .915	.1961	3.36
42	.1701	275	— 57	122	.2002	16	.2018	— .920	.1936	3.21
45	.0810	394	+ 62	125	.1352	648	.2000	+ .939	.2084	3.49
46	.0807	348	+ 62	125	.1293	648	.1941	+ .939	.2025	3.23
47	.0517	330	— 58	130	.0880	.1189	.2069	— .922	.1987	3.43
48	.0329	376	— 59	128	.0735	.1198	.1933	— .922	.1851	2.87
50	.0488	335	— 60	129	.0853	.1201	.2054	— .922	.1972	3.17
51	86.9580	348	+ 60	128	.0077	.1802	.1879	+ .950	.1963	3.10
53	.9715	378	+ 62	132	.0248	.1821	.2069	+ .937	.2153	3.74
58	.9221	427	— 47	128	.9690	.2298	.1988	— .858	.1912	3.25
59	.9275	281	— 49	128	.9596	.2308	.1904	— .874	.1826	2.86
60	.9231	.0313	— .0049	.0128	.9584	+ .2308	.1892	— .874	.1814	2442.88
Mean										2443.288

TABLE XXI.—*Continued.*

Star 30.										
Plate No.	$270^{\circ} + p'$	Re- fract'n	Zero, etc.	Corr. p .	Proper Motion.	p .	Corr. for Orient.	Parallax Coeffi- cient.	Corr. for Paral- lax.	Final corrected Angle.
31	58° 16' 44"	+24"	18 8	35 16"	-4 38"	30 38"	32 30"	+ 7	32 32	32 23
32	16 26	9	18 21	34 56	4 38	30 18	32 20	+ 7	32 22	31 57
33	14 51	34	22 11	37 36	4 34	33 2	32 25	+ 1	32 25	32 9
34	15 44	25	19 32	35 41	-4 34	31 7	32 17	+ 1	32 17	32 28
41	11 33	19	20 2	31 54	+ 1	31 55	32 3	-20	31 58	32 12
58	8 17	+16	17 57	26 30	+6 47	33 17	33 10	-29	33 3	32 32
Mean									58° 32' 16.8	
Star 31.										
31	123 44 6	-18	18 8	1 56	+ 55	2 51	4 43	-49	4 31	4 22
32	44 36	11	18 21	2 46	55	3 41	5 43	-49	5 31	5 6
33	43 33	22	22 11	5 22	54	6 16	5 29	-52	5 16	5 0
34	43 29	19	19 32	2 42	+ 54	3 36	4 46	-52	4 33	4 44
40	42 40	11	21 46	4 15	0	4 15	4 30	+38	4 40	4 13
43	45 32	17	19 52	5 7	21	4 46	4 56	-48	4 44	4 28
44	44 10	13	21 30	5 27	21	5 6	5 21	-48	5 9	4 57
46	41 2	12	21 30	2 20	21	1 59	5 32	-49	5 20	5 2
49	47 14	18	17 40	4 36	39	3 57	4 41	+43	4 52	4 40
50	46 32	6	17 42	4 8	39	3 29	4 38	+43	4 49	4 48
52	50 44	18	17 43	8 9	1 0	7 9	5 8	-49	4 56	4 47
53	50 21	15	17 38	7 44	1 0	6 44	5 29	-49	5 17	4 37
57	48 33	13	17 43	6 3	1 16	4 47	5 26	+27	5 33	4 56
58	49 4	20	17 57	6 41	1 16	5 25	5 18	+27	5 25	4 54
59	49 38	1	17 50	7 27	1 17	6 10	5 36	+29	5 43	5 10
60	50 18	- 3	17 49	8 4	-1 17	6 47	5 31	+29	5 38	4 42
Mean									124° 4' 46.6	
Star 32.										
31	86 15 29	+10	18 8	33 47	-3 29	30 18	32 10	-32	32 2	31 53
32	15 0	0	18 21	33 21	3 29	29 52	31 54	-32	31 46	31 21
33	12 59	20	22 11	35 30	3 26	32 4	31 27	-38	31 17	31 1
34	14 34	11	19 32	34 17	3 26	30 51	32 1	-38	31 51	32 2
38	11 26	16	19 35	31 17	- 55	30 22	30 53	-32	30 45	30 4
40	9 26	4	21 46	31 16	+ 1	31 17	31 32	+11	31 35	31 8
42	12 6	4	19 59	32 9	2	32 11	31 25	+14	31 29	31 23
45	11 26	6	19 40	31 12	1 21	32 33	31 50	-30	31 42	31 27
46	5 44	0	21 30	27 14	1 21	28 35	32 8	-30	32 0	31 42
47	11 38	5	18 42	30 25	2 28	32 53	31 51	+16	31 55	31 48
48	11 1	4	17 45	28 50	2 30	31 20	31 16	+20	31 21	31 11
50	10 0	5	17 42	28 47	2 30	31 17	32 26	+21	32 31	32 30
51	11 0	0	17 52	28 52	3 45	32 37	31 23	-24	31 17	31 4
53	11 46	3	17 38	29 27	3 48	33 15	32 0	-30	31 52	31 12
58	9 40	1	17 57	27 38	4 53	32 31	32 24	- 1	32 24	31 53
59	10 8	4	17 50	28 2	4 54	32 56	32 22	- 2	32 22	31 49
60	10 57	+ 5	17 49	28 51	+4 54	33 45	32 29	- 2	32 29	31 33
Mean									86° 31' 28.3	

TABLE XX.—*Continued.*

Star 33.		Re-	Aberra-	Division	Cor-	Proper	Cor-	Parallax	Corr.	Final
Plate	Measured	fract'n.	tion.	Error.	rected	Motion.	rected	Coeffi-	for	Corrected
No.	Distance.				s.		for	cient.	Paral-	Distance
							p. m.		ax.	in Ar.
31	33.4073	.0163	+ .0024	.0121	.4377	— .1634	.2743	+ .949	.2827	932.51
32	.4040	128	+ 24	120	.4308	.1635	.2673	+ .948	.2757	2.26
33	.3798	189	+ 24	119	.4126	— .1611	.2515	+ .923	.2597	1.84
41	.2488	182	— 21	127	.2772	+ .0006	.2778	— .920	.2696	2.19
42	.2572	104	— 22	121	.2771	15	.2786	— .927	.2703	2.25
43	.1710	157	+ 24	123	.2010	626	.2636	+ .957	.2721	2.19
44	.1697	137	+ 24	124	.1970	626	.2596	+ .957	.2681	2.06
46	.1872	132	+ 24	120	.2144	629	.2773	+ .955	.2858	2.60
50	.1391	127	— 23	122	.1613	.1165	.2778	— .932	.2695	2.17
51	.0598	132	+ 23	120	.0869	.1747	.2616	+ .962	.2702	2.18
57	.0262	140	— 18	124	.0504	.2228	.2732	— .854	.2656	2.16
58	.0086	162	— 18	123	.0349	.2228	.2577	— .854	.2501	1.73
59	.0240	107	— 19	123	.0447	.2237	.2684	— .871	.2607	1.96
60	.0241	.0118	— .0019	.0123	.0459	+ .2237	.2696	— .871	.2619	932.02
Mean										932.151
Star 34.										
31	16.4860	.0082	+ .0012	.0068	.5022	— .1910	.3112	+ .693	.3174	457.18
32	.4725	60	+ 12	70	.4867	.1910	.2957	+ .693	.3019	6.72
33	.4670	99	+ 12	74	.4855	— .1882	.2973	+ .635	.3029	6.76
42	.2831	53	— 11	68	.2941	+ .0018	.2959	— .769	.2891	6.43
48	.1710	68	— 11	71	.1838	.1360	.3198	— .745	.3132	7.09
51	.0800	61	+ 11	67	.0939	.2046	.2985	+ .747	.3051	6.84
57	.0454	66	— 8	65	.0577	.2610	.3187	— .807	.3115	7.08
58	.0172	72	— 8	65	.0301	.2610	.2911	— .807	.2839	6.30
59	.0364	55	— 9	.0065	.0475	.2621	.3096	— .805	.3024	6.79
60	.0326	.0059	— .0009	.0065	.0441	.2621	.3062	— .805	.2990	456.71
Mean										456.790
Star 35.										
31	120.4367	.0488	+ .0086	.0118	.4952	— .1062	.3890	+ 1.001	.3979	3373.31
Star 36.										
31	126.1870	.0527	+ .0089	.0076	.2438	— .1144	.1294	+ 1.004	.1383	3534.14
Star 37.										
31	63.2164	.0291	+ .0045	+ .0114	.2600	— .1886	.0714	+ .493	.0758	1767.26
48	62.9100	252	— 43	113	.9408	+ .1343	.0751	— .576	.0700	7.18
57	.7824	245	— 34	113	.8134	.2577	.0711	— .709	.0648	7.19
58	.7598	.0256	— .0034	+ .0111	.7917	+ .2577	.0494	— .709	.0431	1766.58
Mean										1767.052
Star 38.										
31	116.8672	.0560	+ .0083	.0122	.9341	— .1908	.7433	+ .572	.7484	3271.06
33	.8352	680	+ 84	125	.9145	— .1880	.7265	+ .505	.7310	70.45
48	.5530	474	— 79	121	.5950	+ .1360	.7310	— .643	.7253	70.57
57	.3850	466	— 62	122	.4280	.2608	.6888	— .750	.6821	69.63
58	.4007	495	— 62	125	.4469	.2608	.7077	— .750	.7010	70.17
60	.4274	.0428	— .0065	.0118	.4659	+ .2619	.7278	— .742	.7212	3270.60
Mean										3270.413
Star 39.										
31	99.6372	.0488	+ .0071	.0138	.7008	— .1915	.5093	+ .646	.5150	2788.21

TABLE XXI.—*Continued.*

Star 33.		Re-	Zero,	Corr.	Proper	ρ .	Corr.	Parallax	Corr.	Final
Plate	$270^\circ + \rho'$.	fract'n.	etc.	ρ .	Motion.	ρ .	for	Coeffi-	for	corrected
No.							Orient.	cient.	Paral-	Angle.
31	83 26' 50"	+13"	18' 8"	45' 11"	—1' 11"	44' 0"	45' 52"	—73	45 34	45 25
32	28 10	1	18 21	46 32	1 11	45 21	47 23	—73	47 5	46 40
33	23 52	23	22 11	46 26	—1 2	45 24	44 47	—91	44 24	44 8
41	15 6	0	20 2	35 8	+	35 10	35 18	+18	35 22	35 36
42	17 12	4	19 59	37 15	6	37 21	36 35	+18	36 39	36 33
43	11 46	9	19 52	31 47	3 56	35 43	35 53	—64	35 37	35 21
44	11 2	3	21 30	32 35	3 56	36 31	36 46	—64	36 30	36 18
46	8 44	3	21 30	30 17	3 57	34 14	37 47	—67	37 30	37 12
50	8 47	6	17 42	26 35	7 20	33 55	35 4	+44	35 15	35 14
51	8 21	2	17 52	26 15	11 1	37 16	36 2	—53	35 49	35 36
57	4 16	5	17 43	22 4	14 20	38 24	39 3	—23	38 57	38 20
58	5 55	2	17 57	23 54	14 20	38 14	38 7	—23	38 1	37 30
59	8 10	4	17 50	26 4	14 24	40 28	39 54	—15	39 50	39 17
60	8 43	+5	17 49	26 37	+14 24	41 1	39 45	—15	39 41	38 45
Mean										83°38'42.5
Star 31.										
31	110 32 22	—9	18 8	50 21	—2 51	47 37	49 22	—328	48 0	47 51
32	37 18	—9	18 21	55 30	2 51	52 39	54 41	—328	53 19	52 54
33	31 24	—8	22 11	53 27	—2 48	50 39	50 2	—354	48 34	48 18
42	28 53	+2	19 59	48 54	+2	48 56	48 10	+240	49 10	49 4
48	23 34	—7	17 45	41 12	2 4	43 16	43 12	+266	44 18	44 8
51	30 20	—10	17 52	48 2	3 8	51 10	49 56	—294	48 42	48 29
57	27 36	—8	17 43	45 11	4 5	49 16	49 55	+134	50 29	49 52
58	29 17	—16	17 57	47 8	4 5	51 13	51 6	+134	51 40	51 9
59	29 17	+2	17 50	47 9	4 6	51 15	50 41	+153	51 19	50 46
60	32 4	+0	17 49	49 53	+4 6	53 59	52 43	+153	53 21	52 25
Mean										110°49'29.6
Star 35.										
31	58 25 8	+24	18 8	43 40	—4 26	39 14	41 6	+6	41 8	40 59
Mean										58°
Star 36.										
31	61 26 39	+23	18 8	45 10	—4 4	41 6	42 58	+3	42 59	42 50
Mean										61°
Star 37.										
31	124 44 6	—19	18 8	1 55	+1 56	3 51	5 43	—102	5 17	5 18
48	47 39	12	17 45	5 12	—1 22	3 50	3 46	+88	4 8	3 58
57	50 6	13	17 43	7 36	2 42	4 54	5 33	+56	5 47	5 10
58	50 24	—21	17 57	8 0	—2 42	5 18	5 11	+56	5 25	4 54
Mean										125°4'50.0
Star 38.										
31	119 27 2	—16	18 8	44 54	+34	45 28	47 20	—52	47 7	46 58
33	24 38	—17	22 11	46 32	+34	47 6	46 29	—55	46 15	45 59
48	28 3	—10	17 45	45 38	—24	45 14	45 10	+44	45 21	45 11
57	29 15	—11	17 43	46 47	48	45 59	46 38	+26	46 44	46 7
58	30 12	—19	17 57	47 50	48	47 2	46 55	+26	47 1	46 30
60	31 10	—2	17 49	48 57	—48	48 9	46 53	+29	47 0	46 4
Mean										119°46'8.2
Star 39.										
31	114 7 28	—12	18 8	25 24	+2	25 26	27 18	—56	27 4	26 55

TABLE XX.—*Continued.*

Star 40.		Re-	Aberra-	Division	Cor-	Proper	Cor-	Parallax	Corr.	Final
Plate	Measured	fract'n.	tion.	Error.	rected	Motion.	rected	Coeffi-	for	Corrected
No.	Distance.				s.		for	cient.	Paral-	Distance
							p. m.		lax.	in Arc.
31	94.0268	.0461	+.0067	+.0144	.0890	— .1915	.8975	+.655	.9033	2630.98
33	93.9832	.0544	68	140	.0534	— .1887	.8647	+.593	.8700	2629.96
58	.5932	.0417	— .0050	+.0140	.6389	+.2617	.9006	— .791	.8930	2631.07
Mean										2630.670
Star 41.										
31	108.1522	.0294	+.0077	.0122	.1937	— .0425	.1512	— .615	.1457	3030.03
32	.1672	304	+	77	120	.2095	— .0425	.1670	— .615	.1615
40	.0906	331	—	69	117	.1207	+.0002	.1209	+.372	.1242
43	.1153	300	+	76	120	.1571	162	.1733	— .579	.1682
45	.1048	300	+	76	120	.1466	163	.1629	— .590	.1577
48	.0613	329	—	73	120	.0911	300	.1211	+.472	.1253
51	.0887	303	+	75	120	.1307	451	.1758	— .533	.1711
57	.0492	317	—	58	117	.0790	575	.1365	+.171	.1380
58	.0440	334	—	58	117	.0755	575	.1330	+.171	.1345
59	.0509	330	—	61	118	.0818	578	.1396	+.213	.1415
60	.0502	.0328	— .0061	.0117	.0808	+.0578	.1386	+.213	.1405	3030.16
Mean										3030.192
Star 42.										
31	108.9768	.0299	+.0078	.0133	.0200	— .0362	.9838	— .642	.9781	3053.34
32	.9926	310	+	78	124	.0360	— .0362	.9998	— .642	.9941
40	.9310	337	—	70	124	.9623	+.0001	.9624	+.401	.9660
41	.9328	363	—	70	132	.9675	1	.9676	+.401	.9712
42	.9344	326	—	72	132	.9652	3	.9655	+.439	.9694
47	.9017	331	—	73	124	.9321	253	.9574	+.463	.9615
48	.8948	334	—	74	125	.9255	255	.9510	+.501	.9554
50	.9082	332	—	75	125	.9386	256	.9642	+.513	.9688
53	.9081	314	+	77	125	.9529	387	.9916	— .625	.9860
57	.8946	322	—	58	124	.9256	488	.9744	+.201	.9762
58	.8879	340	—	58	124	.9207	488	.9695	+.201	.9713
59	.9010	332	—	61	118	.9321	491	.9812	+.243	.9834
60	.9047	.0330	—	61	.0124	.9362	+.0491	.9853	+.243	.9875
Mean										3053.424
Star 43.										
31	110.2702	.0324	+.0078	+.0127	.3149	+.0090	.3239	— .804	.3168	3090.86
58	.2804	.0384	— .0058	+.0127	.3175	— .0128	.3047	+.391	.3082	3091.03
Mean										3090.945
Star 44.										
41	120.5340	.0388	— .0078	+.0112	.5655	— .0002	.5653	— .326	.5624	3378.06
48	.5818	368	—	82	108	.6105	— .375	.5730	— .427	.5692
57	.5911	353	—	65	108	.6200	— .720	.5480	— .126	.5469
58	.6146	305	—	65	108	.6457	— .720	.5737	— .126	.5726
59	.5966	.0373	— .0068	+.0108	.6272	— .0723	.5549	— .168	.5534	3377.91
Mean										3378.168

TABLE XXI.—*Continued.*

Star 40.		Re- fract'n	Zero, etc.	Corr. ϕ .	Proper Motion.	ϕ .	Corr. for Orient.	Parallax Coefficient.	Corr. for Paral- lax.	Final corrected Angle.
Plate No.	$270^\circ + \phi$.									
31	$113^\circ 29' 56''$	$-11''$	$18' 8''$	$47' 53''$	$-2''$	$47' 51''$	$49' 43''$	-60	$49' 28''$	$49' 19''$
33	$28' 52''$	$-11''$	$22' 11''$	$50' 52''$	$-2''$	$50' 50''$	$50' 13''$	-63	$49' 57''$	$49' 41''$
58	$32' 11''$	$-17''$	$17' 57''$	$49' 51''$	$+4''$	$49' 55''$	$49' 48''$	$+26$	$49' 54''$	$49' 23''$
Mean									$113^\circ 49' 27.7$	
Star 41.										
31	$191^\circ 48' 37''$	$+2$	$18' 8''$	$6' 47''$	$+6' 3''$	$12' 50''$	$14' 42''$	-54	$14' 28''$	$14' 19''$
32	$47' 44''$	6	$18' 21''$	$6' 11''$	$+6' 3''$	$12' 14''$	$14' 16''$	-54	$14' 2''$	$13' 37''$
40	$51' 21''$	3	$21' 46''$	$13' 10''$	-1	$13' 9''$	$13' 24''$	$+57$	$13' 38''$	$13' 11''$
43	$56' 54''$	4	$19' 52''$	$16' 50''$	$2' 17''$	$14' 33''$	$14' 43''$	-55	$14' 29''$	$14' 13''$
45	$57' 56''$	5	$19' 40''$	$17' 41''$	$2' 40''$	$15' 1''$	$14' 18''$	-55	$14' 4''$	$13' 49''$
48	$192^\circ 0' 16''$	5	$17' 45''$	$18' 6''$	$4' 19''$	$13' 47''$	$13' 43''$	$+55$	$13' 57''$	$13' 47''$
51	$4' 26''$	7	$17' 52''$	$22' 25''$	$6' 29''$	$15' 56''$	$14' 42''$	-57	$14' 28''$	$14' 15''$
57	$4' 28''$	4	$17' 43''$	$22' 15''$	$8' 25''$	$13' 50''$	$14' 29''$	$+57$	$14' 43''$	$14' 6''$
58	$4' 57''$	$+12$	$17' 57''$	$23' 6''$	$8' 25''$	$14' 41''$	$14' 34''$	$+57$	$14' 48''$	$14' 17''$
59	$5' 29''$	-3	$17' 50''$	$23' 16''$	$8' 28''$	$14' 48''$	$14' 14''$	$+57$	$14' 28''$	$13' 55''$
60	$6' 38''$	-2	$17' 49''$	$24' 25''$	$-8' 28''$	$15' 57''$	$14' 41''$	$+57$	$14' 55''$	$13' 59''$
Mean									$192^\circ 13' 57.1$	
Star 42.										
31	$193^\circ 44' 48''$	$+4$	$18' 8''$	$4' 0''$	$+6' 3''$	$10' 3''$	$11' 55''$	-52	$11' 42''$	$11' 33''$
32	$44' 51''$	$+7$	$18' 21''$	$3' 19''$	$+6' 3''$	$9' 22''$	$11' 24''$	-52	$11' 11''$	$10' 46''$
40	$48' 35''$	$+4$	$21' 46''$	$10' 25''$	-1	$10' 24''$	$10' 39''$	$+56$	$10' 53''$	$10' 26''$
41	$49' 42''$	$+17$	$20' 2''$	$10' 1''$	-1	$10' 0''$	$10' 8''$	$+56$	$10' 22''$	$10' 36''$
42	$50' 58''$	-2	$19' 59''$	$10' 55''$	3	$10' 52''$	$10' 6''$	$+55$	$10' 20''$	$10' 14''$
47	$57' 12''$	-0	$18' 42''$	$15' 54''$	$4' 16''$	$11' 38''$	$10' 36''$	$+55$	$10' 50''$	$10' 43''$
48	$56' 35''$	$+5$	$17' 45''$	$14' 25''$	$4' 18''$	$10' 7''$	$10' 3''$	$+55$	$10' 17''$	$10' 7''$
50	$55' 26''$	$+0$	$17' 42''$	$13' 8''$	$4' 19''$	$8' 49''$	$9' 58''$	$+54$	$10' 12''$	$10' 11''$
53	$194^\circ 0' 38''$	$+8$	$17' 38''$	$18' 24''$	$6' 33''$	$11' 51''$	$10' 36''$	-53	$10' 23''$	$9' 43''$
57	$1' 2''$	$+5$	$17' 43''$	$18' 50''$	$8' 25''$	$10' 25''$	$11' 4''$	$+57$	$11' 18''$	$10' 41''$
58	$0' 48''$	$+13$	$17' 57''$	$18' 58''$	$8' 25''$	$10' 33''$	$10' 26''$	$+57$	$10' 40''$	$10' 9''$
59	$2' 22''$	-3	$17' 50''$	$20' 9''$	$8' 27''$	$11' 42''$	$11' 8''$	$+57$	$11' 22''$	$10' 49''$
60	$3' 12''$	-1	$17' 49''$	$21' 0''$	$-8' 27''$	$12' 33''$	$11' 17''$	$+57$	$11' 31''$	$10' 35''$
Mean									$194^\circ 10' 30.2$	
Star 43.										
31	$207^\circ 21' 22''$	$+14$	$18' 8''$	$39' 44''$	$+6' 4''$	$45' 48''$	$47' 40''$	-40	$47' 30''$	$47' 21''$
58	$37' 41''$	$+19$	$17' 57''$	$55' 57''$	$-8' 27''$	$47' 50''$	$47' 23''$	$+51$	$47' 36''$	$47' 5''$
Mean									$207^\circ 47' 13.0$	
Star 44.										
41	$8' 52' 46''$	$+13$	$20' 2''$	$13' 1''$	$+1$	$13' 2''$	$13' 10''$	-56	$12' 56''$	$12' 42''$
48	$51' 44''$	$+2$	$17' 45''$	$4' 31''$	$3' 55''$	$13' 26''$	$13' 22''$	-55	$13' 8''$	$12' 58''$
57	$47' 38''$	$+3$	$17' 43''$	$5' 24''$	$7' 40''$	$13' 4''$	$13' 43''$	-56	$13' 29''$	$12' 52''$
58	$48' 5''$	$+10$	$17' 57''$	$6' 12''$	$7' 40''$	$13' 52''$	$13' 45''$	-56	$13' 31''$	$13' 0''$
59	$49' 51''$	-2	$17' 50''$	$7' 39''$	$+7' 42''$	$15' 21''$	$14' 47''$	-56	$14' 33''$	$14' 0''$
Mean									$9^\circ 13' 6.4$	

TABLE XX.—*Continued.*

Star 45.		Re-	Aberra-	Division	Cor-	Proper	Cor-	Parallax	Corr.	Final
Plate	Measured	fract'n.	tion.	Error.	rected	Motion.	rected	Coeffi-	for	Corrected
No.	Distance.				s.		for	cient.	Paral-	Distance
							p. m.		lax.	in Arc.
42	111.8687	.0333	— .0074	.0114	.8974	— .0002	.8972	— .523	.8926	3135.29
57	.8775	.338	— 60	.114	.9081	— 222	.8859	— .288	.8833	3135.16
58	.8835	.0366	— .0060	.0114	.9169	— .0222	.8947	— .288	.8921	3135.42
Mean										3135.290
Star 46.										
57	127.7398	.0386	— .0069	.0029	.7616	— .1822	.5794	+ .290	.5820	3575.06
59	.7456	.0413	— .0071	.0029	.7699	— .1829	.5870	+ .256	.5893	257.05
Mean										3575.055
Star 47.										
48	109.5100	.0429	— .0074	.0118	.5491	— .1332	.4159	+ .542	.4207	3065.90
50	.4986	.414	— 75	.116	.5.59	— .1335	.4024	+ .533	.4071	5.47
57	.6329	.417	— 58	.123	.6729	— .25.5	.4174	+ .686	.4235	6.23
59	.6388	.377	— 61	.127	.6749	— .2566	.4183	+ .672	.4210	6.06
60	.6448	.0397	— .0061	.0127	.6829	— .2566	.4263	+ .672	.4323	3 66.36
Mean										3066.004
Star 48.										
59	126.4305	.0436	— .0071	.0038	.4584	— .2619	.1965	+ .809	.2037	3536.23
Star 49.										
57	69.6284	.0269	— .0037	.0127	.6622	— .2558	.4064	+ .689	.4125	1945.06
59	.6380	.0241	— 39	.0130	.6691	— .2568	.4123	+ .675	.4183	10
60	.6317	.0255	— .0039	.0130	.6642	— .2568	.4074	+ .675	.4134	1945.00
Mean										1945.053
Star 50.										
59	111.3061	.0380	— .0076	.0112	.3391	— .2542	.0849	+ .853	.0925	3112.81
Star 51.										
58	109.4072	.0510	— .0058	.0128	.4570	— .1667	.2903	+ .823	.2976	3062.72
59	.4494	.0344	— .0061	.0123	.4818	— .1674	.3144	+ .800	.3215	3063.19
Mean										3062.955
Star 53.										
57	64.3566	.0205	— .0035	.0104	.3822	— .0221	.3601	+ .415	.3638	1803.58
58	.3638	.229	— 35	.102	.3916	— 221	.3695	+ .415	.3732	85
59	.3542	.194	— 36	.102	.3784	— 221	.3562	+ .455	.3602	.37
60	.3622	.0196	— .0036	.0102	.3866	— .0222	.3644	+ .455	.3684	1803.64
Mean										1803.610
Star 54.										
50	53.8432	.0201	— .0037	.0118	.8703	+ .1024	.9727	— .951	.9642	1512.02
57	.7413	.0222	— .0029	.0111	.7706	+ .1962	.9668	— .821	.9595	1512.04
Mean										1512.030
Star 56.										
50	53.6448	.0178	— .0037	.0112	.6690	+ .0501	.7191	— .864	.7114	1504.93

TABLE XXI.—*Continued.*

Star 45.		Re-	Zero,	Corr.	Proper	ϕ .	Corr.	Parallax	Corr.	Final
Plate	$270^\circ + \rho'$.	fract'n.	etc.	ϕ .	Motion.		for	Coeffi-	for	corrected
No.							Orient.	cient.	Paral-	Angle.
42	19 57 46	— 2	19 59	17 43	+ 3	17 46	17 0	—51	16 47	16 41
57	51 53	+ 8	17 43	9 44	8 1	17 45	18 24	—53	18 11	17 34
58	52 3	+16	17 57	10 16	+8 1	18 17	18 10	—53	17 57	17 26
Mean									20° 17' 13.7	
Star 46.										
57	340 40 20	—10	17 43	57 53	+5 0	2 53	3 32	—46	3 21	2 27
59	41 19	— 5	17 50	59 4	+5 1	4 5	3 31	—47	3 19	2 46
Mean									341° 2' 36.5	
Star 47.										
48	307 17 6	—12	17 45	34 39	+ 51	35 30	35 26	—52	35 13	35 3
50	15 43	7	17 42	33 18	51	34 9	35 18	—53	35 5	35 4
57	15 47	13	17 43	33 17	1 39	34 56	35 35	—35	35 26	34 49
59	16 40	1	17 50	34 29	1 40	36 9	35 35	—37	35 26	34 53
60	17 24	— 4	17 49	35 9	+1 40	36 49	35 33	—37	35 24	34 28
Mean									307° 34' 51.4	
Star 48.										
59	289 54 20	+ 2	17 50	12 12	— 46	11 26	10 52	—20	10 47	10 14
Star 49.										
57	307 1 34	—13	17 43	19 4	+2 38	21 42	22 21	—54	22 8	21 31
59	0 23	— 1	17 50	18 12	2 39	20 51	20 17	—59	20 2	19 29
60	2 53	— 4	17 49	20 38	+2 39	23 17	22 1	—59	21 46	20 50
Mean									307° 20' 36.7	
Star 50.										
59	280 5 44	— 8	17 40	23 16	—2 15	21 1	20 27	—12	20 24	19 51
Star 51.										
58	244 14 28	+14	17 57	32 39	—6 37	26 2	25 55	+26	26 1	25 30
59	15 47	+ 4	17 50	33 41	—6 38	27 3	26 29	+24	26 35	26 2
Mean									244° 25' 46.0	
Star 53.										
57	209 27 42	+11	17 43	45 36	—14 21	31 15	31 54	+86	32 16	31 39
58	27 34	19	17 57	45 50	14 21	31 29	31 22	+86	31 44	31 13
59	28 16	0	17 50	46 6	14 24	31 42	31 8	+85	31 29	30 56
60	29 23	+ 2	17 49	47 14	—14 24	32 50	31 34	+85	31 55	30 59
Mean									209° 31' 11.7	
Star 54.										
50	73 26 45	+ 8	17 42	44 35	+ 5 41	50 16	51 25	+ 5	51 26	51 25
57	21 35	+ 9	17 43	39 27	+11 6	50 33	51 12	—33	51 4	50 27
Mean									73° 50' 56.0	
Star 56.										
50	46 21 19	+ 8	17 42	39 9	+ 8 4	47 13	48 22	—55	48 8	48 7

TABLE XX.—*Continued.*

Star 57.		Re-	Aberra-	Division	Cor-	Proper	Cor-	Parallax	Corr.	Final
Plate	Measured	fract'n.	tion.	Error.	rected	Motion.	rected	Coeffi-	for	Corrected
No.	Distance.				s.		for	cient.	Paral-	Distance
							p. m.		lax.	in Arc.
50	69.3652	.0228	— .0047	.0128	.3940	+ .0453	.4403	— .852	.4327	1945.43
57	.3176	.0242	— .0037	.0130	.3490	+ .0884	.4374	— .601	.4321	1945.60
Mean										1945.515
Star 7.										
31	70.3398	.0318	+ .0050	.0132	.3877	— .1371	.2506	+ .997	.2513	1968.30
32	.3387	.265	+ 50	127	.3808	.1371	.2436	+ .997	.2443	7.97
33	.3366	.355	+ 51	127	.3878	.1350	.2528	+ .989	.2535	8.29
34	.3396	.330	+ 51	126	.3882	.1350	.2532	+ .989	.2539	8.29
36	.2431	.326	+ 47	127	.2910	450	.2460	+ .975	.2467	8.28
37	.2588	.291	+ 47	127	.3032	450	.2582	+ .976	.2589	8.24
38	.2426	.343	+ 50	126	.2924	— .0398	.2526	+ .998	.2533	8.39
40	.2072	.288	— 45	134	.2428	+ .0005	.2433	— .915	.2427	8.30
41	.1944	.368	— 45	128	.2374	5	.2379	— .915	.2373	7.99
42	.2203	.215	— 46	132	.2483	13	.2496	— .930	.2490	8.41
43	.1699	.313	+ 50	128	.2169	525	.2694	+ .997	.2701	8.76
44	.1620	.282	+ 50	135	.2066	525	.2591	+ .997	.2598	8.73
45	.1635	.300	+ 50	128	.2092	528	.2620	+ .996	.2627	8.69
46	.1812	.273	+ 50	126	.2240	528	.2768	+ .996	.2775	9.03
47	.1216	.252	— 47	125	.1525	967	.2492	— .937	.2486	8.46
48	.1258	.289	— 48	128	.1606	975	.2581	— .949	.2573	8.57
49	.1128	.333	— 48	126	.1518	975	.2493	— .949	.2487	8.33
50	.1298	.259	— 48	126	.1614	977	.2591	— .953	.2584	8.56
51	.0776	.273	+ 49	126	.1203	.1467	.2670	— .991	.2677	8.79
52	.0671	.319	+ 50	126	.1145	.1482	.2627	— .998	.2634	8.48
53	.0746	.292	+ 50	126	.1193	.1482	.2675	— .998	.2682	8.89
54	.0603	.371	— 50	132	.1135	.1487	.2622	— .997	.2629	8.62
55	.0662	.334	+ 50	132	.1157	.1487	.2644	+ .997	.2651	8.85
56	.0677	.301	+ 50	134	.1141	.1487	.2628	— .997	.2635	8.87
57	.0471	.286	— 38	132	.0830	.1870	.2700	— .809	.2694	9.07
58	.0337	.335	— 38	132	.0745	.1870	.2615	— .809	.2609	8.84
59	.0445	.225	— 39	132	.0742	.1878	.2620	— .814	.2614	8.72
60	.0384	.0241	— .0039	.0132	.0697	— .1878	.2575	— .834	.2569	1968.64
Mean										1968.549

TABLE XXI.—*Continued.*

Star 57.											
Plate No.	270° + p'.		Re-fract'n.	Zero, etc.	Corr. p.	Proper Motion.	p.	Corr. for Orient.	Parallax Coefficient.	Corr. for Parallax.	Final corrected Angle.
50	44	37 34	+ 8"	17 42	55 24	+ 6' 14"	1 38"	2 47"	—45	2 36	2 35
57		32 59	+ 14	17 43	50 56	+ 12' 17	3 13	3 52	—65	3 36	2 59
Mean										45° 2' 47.0	
Star θ.											
31	70	32 33	+ 20	18 8	51 1	— 6 25	44 36	46 28	—11	46 28	46 19
32		31 48	6	18 21	50 15	6 25	43 50	45 52	—12	45 52	45 27
33		30 9	31	22 11	52 51	6 20	46 31	45 54	—20	45 54	45 38
34		30 50	22	19 32	50 44	6 20	44 24	45 34	—20	45 34	45 45
36		28 49	26	19 55	49 10	2 7	47 3	46 23	+ 5	46 23	45 40
37		26 6	12	20 12	46 30	2 7	44 23	45 38	+ 5	45 38	45 50
38		28 30	26	19 35	48 31	— 1 42	47 49	48 20	—17	48 20	47 39
40		23 54	10	21 46	45 50	+	45 51	46 6	13	46 6	45 39
41		25 54	10	20 2	46 6	1	46 7	46 15	13	46 15	46 29
42		26 39	3	19 59	46 41	4	46 45	45 59	9	45 59	45 53
43		24 18	16	19 52	44 26	2 28	46 54	47 4	7	47 4	46 48
44		21 55	9	21 30	43 34	2 28	46 2	46 17	7	46 17	46 5
45		24 38	14	19 40	44 32	2 29	47 1	46 18	9	46 18	46 3
46		18 50	7	21 30	40 27	2 29	42 56	46 29	9	46 29	46 11
47		24 5	8	18 42	42 55	4 33	47 28	46 26	7	46 26	46 19
48		23 17	10	17 45	41 12	4 35	45 47	45 43	3	45 43	45 33
49		23 13	11	17 40	41 4	4 35	45 39	46 23	3	46 23	46 12
50		22 37	8	17 42	40 27	4 35	45 2	46 11	2	46 11	46 10
51		22 44	7	17 52	40 43	6 54	47 37	46 23	2	46 23	46 10
52		23 12	19	17 43	41 14	6 59	48 13	46 12	9	46 12	46 3
53		22 33	11	17 38	40 22	6 59	47 21	46 6	9	46 6	45 26
54		24 14	42	17 20	42 16	7 0	49 16	47 0	12	47 0	46 25
55		24 22	25	17 27	42 14	7 0	49 14	46 34	12	46 34	46 21
56		22 5	15	17 32	39 52	7 0	46 52	46 19	12	46 19	45 42
57		18 48	10	17 43	36 41	8 59	45 40	46 19	30	46 18	45 41
58		19 49	10	17 57	37 56	8 59	46 55	46 48	30	46 47	46 16
59		20 42	5	17 50	38 37	9 1	47 38	47 4	27	47 4	46 31
60		21 21	+ 7	17 49	39 17	+ 9 1	48 18	47 2	—27	47 2	46 6
Mean										70° 46' 5.0	

TABLE XXII.

Star No.	Ruth's No.	α 1872.0	Precess.	Sec. Var.	δ 1872.0	Precess.	Sec Var
		h m s			° ' "		
1	48	0 53 24.03	3.5069	+.0539	54 50 20.0	+19.512	-.126
2	3	34.65	3.5119	.0541	54 37 9.8	19.509	.127
3	2	36.38	3.5099	.0542	54 42 18.7	19.508	.127
4	1	36.84	3.4972	.0524	53 53 52.9	19.508	.126
5	50	55.19	3.5081	.0536	54 26 13.8	19.502	.127
6	5	54 0.98	3.5103	.0539	54 31 20.3	19.500	.128
7	4	1.82	3.5044	.0529	54 9 4.0	19.500	.127
8	51	33.47	3.5048	.0526	53 55 2.0	19.489	.129
9	6	48.87	3.5056	.0524	53 50 20.4	19.483	.129
10	47	55 3.05	3.5283	.0555	55 6 30.9	19.479	.130
11	7	55.07	3.5224	.0538	54 20 29.4	19.461	.132
12	8	56 31.21	3.5265	.0538	54 18 11.5	19.448	.134
13	11	34.18	3.5415	.0559	55 9 38.1	19.446	.134
14	10	42.05	3.5191	.0526	53 46 13.9	19.444	.134
15	12	43.79	3.5293	.0540	54 22 47.8	19.443	.134
16	9	44.10	3.5152	.0520	53 31 6.1	19.443	.134
17	49	48.25	3.5340	.0546	54 36 59.2	19.441	.134
18	43	57 4.62	3.5347	.0545	54 31 46.2	19.436	.135
19	14	10.79	3.5453	.0559	55 5 25.1	19.433	.136
20	13	17.00	3.5259	.0532	53 54 19.7	19.431	.136
21	46	30.49	3.5504	.0563	55 13 44.0	19.426	.137
22	15	58 0.66	3.5238	.0518	53 26 39.3	19.415	.137
23	53	5.61	3.5312	.0531	53 51 17.3	19.414	.137
24	16	15.49	3.5337	.0532	53 55 33.3	19.410	.138
25	17	29.36	3.5434	.0544	54 23 17.2	19.405	.138
26	18	33.09	3.5387	.0537	54 5 16.3	19.404	.138
27	41	34.50	3.5284	.0523	53 28 6.7	19.403	.138
28	19	46.71	3.5488	.0549	54 33 58.8	19.399	.139
29	20	55.76	3.5390	.0532	53 56 3.4	19.395	.139
30	22	59 2.03	3.5500	.0548	54 30 57.0	19.393	.140
31	21	2.49	3.5356	.0529	53 40 59.9	19.393	.149
32	23	28.76	3.5590	.0556	54 49 27.6	19.383	.141
33	42	34.49	3.5361	.0525	53 28 7.0	19.381	.140
34	11	46.27	3.5518	.0546	54 17 28.5	19.376	.141
35	24	1 0 5.11	3.5197	.0538	54 1 51.1	19.369	.142
36	25	31.57	3.5598	.0551	54 28 18.4	19.359	.144
37	34	35.01	3.5574	.0545	54 14 46.4	19.358	.143
38	26	44.07	3.5462	.0528	53 32 49.3	19.354	.143
39	44	49.55	3.5771	.0571	55 13 1.2	19.352	.145
40	33	1 32.19	3.5661	.0549	54 19 8.0	19.336	.146
41	56	52.49	3.5735	.0556	54 34 34.0	19.328	.147
42	45	52.98	3.5835	.0568	55 6 24.3	19.328	.147
43	27	2 4.24	3.5635	.0541	53 56 43.8	19.324	.147
44	28	10 90	3.5663	.0544	54 3 15.5	19.321	.147
45	57	24.45	3.5795	.0558	54 40 16.0	19.316	.148
46	37	30.35	3.5680	.0543	54 0 26.7	19.313	.148
47	54	32.66	3.5756	.0553	54 24 21.3	19.312	.149
48	29	41.25	3.5664	.0538	53 49 21.2	19.308	.149
49	11	3 19.54	3.5829	.0554	54 28 4.1	19.294	.152
50	40	4 18.17	3.5816	.0546	53 59 31.6	19.270	.153
51	32	25.12	3.5888	.0555	54 19 35.7	19.267	.153
52	39	33 97	3.5831	.0545	53 57 53.8	19.264	.153
53	30	5 5.00	3.6023	.0566	54 45 9.6	19.251	.155
54	38	7.14	3.5840	.0543	53 49 58.7	19.250	.154
55	35	19 39	3.6045	.0566	54 46 12.6	19.245	.155
56	31	22.13	3.5847	.0541	53 43 23.5	19.244	.155
57	36	45 84	3.6076	.0567	54 44 19.3	19.234	.157

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VITA.

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*The three unnumbered publications and the contributions numbered 3 to 7 and 10 to 15 (inclusive) have been gathered together in a volume of 614 pages entitled RUTHERFURD: STELLAR PHOTOGRAPHS: Vol. I.; PLEIADES: CYGNUS: CASSIOPEIÆ: PRÆSEPE, by REES, JACOBY, DAVIS AND SCHLESINGER, 1898.

The volume is supplied with a consecutive pagination, table of contents and a preface. Only a few volumes have been distributed because of the scarcity of several of the papers. Any one having copies of the papers included in this volume and desiring to bind them will be supplied, on request, with the table of contents, title pages and preface.

Beginning with No. 16 all the contributions relating to the Rutherford Photographs will be paged consecutively at the bottom of the pages, and in due time will be assembled in a second Rutherford volume.

Contributions Nos. 8 and 9 (in preparation) will form a quarto volume of some 400 pages.